MACHINE DESIGN

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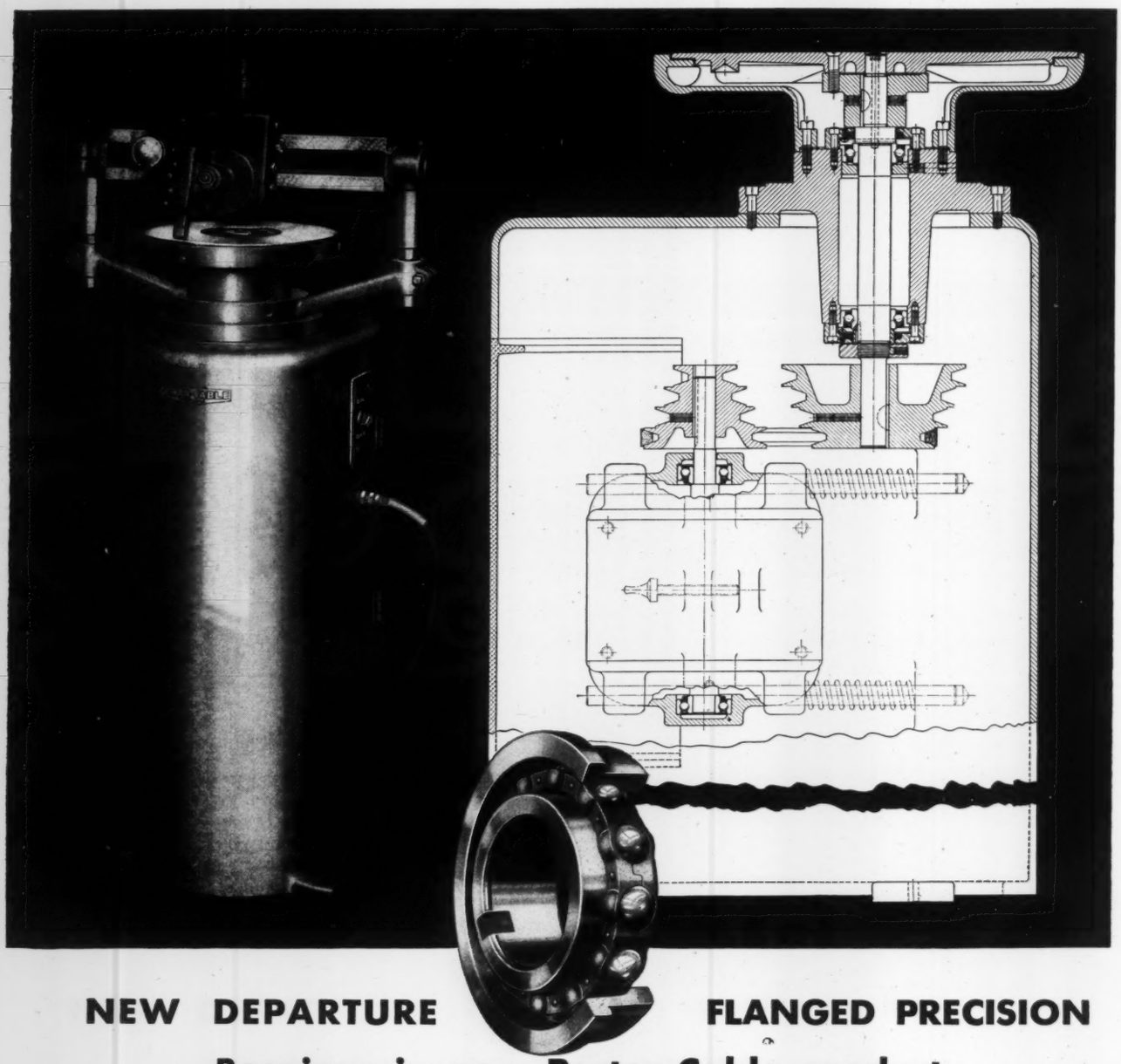

NEW DEPARTURE FLANGED PRECISION

Bearings in new Porter-Cable product

Lapped cutting edges on tungsten carbide tools produce from two to four times as much work as edges that are only ground. With a new machine developed by Porter-Cable the tool is held in a carriage at any desired angle and a revolving lap does the work. The operator moves the tool back and forth during the process to prevent gouging of the lap. New Departure Flanged Precision bearings support the main spindle with accuracy and rigidity. N-D-Seals in the vertical motor eliminate lubrication worries. Come to New Departure for bearing recommendations. The New Departure Manufacturing Company, Bristol, Connecticut. . . . Branches located at Detroit, Chicago, San Francisco and London.

NEW DEPARTURE
BALL BEARINGS

2193

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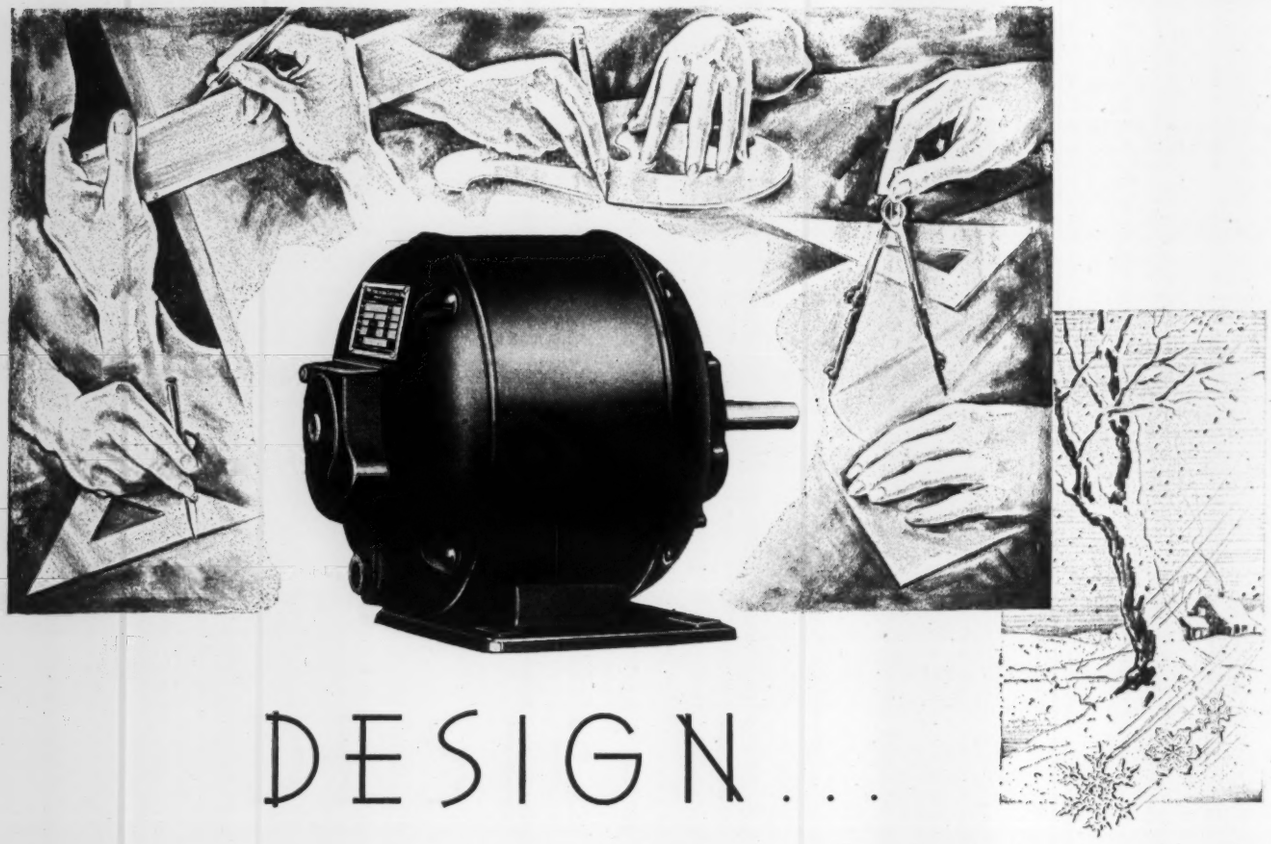


DESIGN...

The genius of Emerson Engineers really finds expression inside the covers of the Emerson Motor, for it is here that the great difference in adaptability to a specific task occurs.

Long years of patient research—hundreds of tests with specially designed scientific equipment—precision manufacturing—all play a vital part in the designing of an individual motor for your individual needs.

Emerson's facilities are splendidly capable of meeting the varying requirements of design, quantity and delivery—and Emerson's modern production methods enable Emerson Motors to be sold competitively. Write today for booklet 3-M. "A Trip thru the Emerson Plant".

HUMPHREY GAS UNIT HEATER

Motor designed by Emerson

The General Gas Light Company, Kalamazoo, Michigan, has pioneered and progressed remarkably in the development of forced circulation gas heating equipment for domestic, commercial and industrial use. The motor in its Humphrey Gas Unit Heaters was designed by Emerson.

EMERSON MOTORS

3 HP and smaller—Single-phase—Polyphase—Direct Current

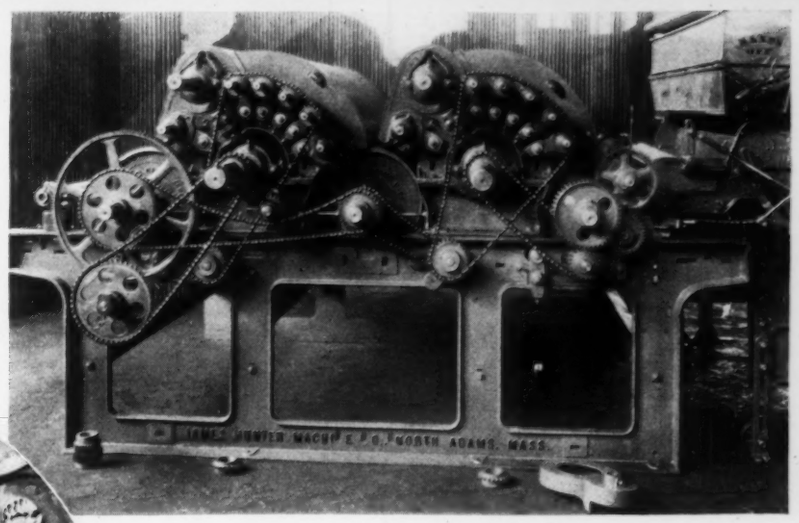
THE EMERSON ELECTRIC MFG. CO.

NEW YORK ST. LOUIS CHICAGO

LEADERS IN THE FAN AND MOTOR INDUSTRY SINCE 1890

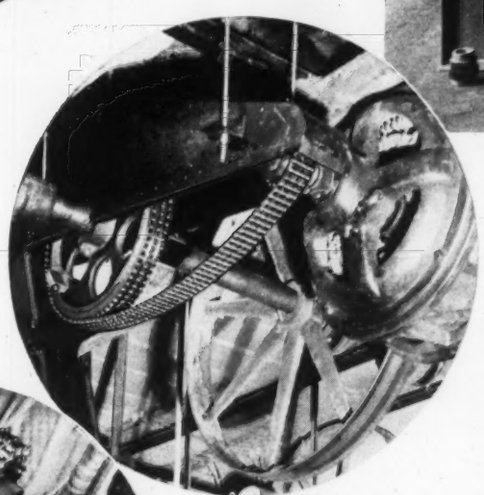
ON THE MACHINES and IN THE PLANTS

The manufacturers of production machinery use Diamond Roller Chain in many ways. The Garnett shown is for "carding" wool.

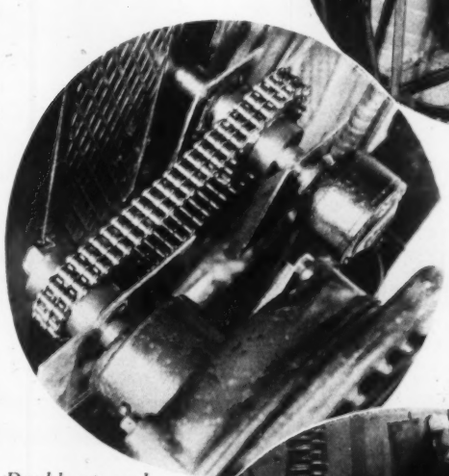


For the Designers

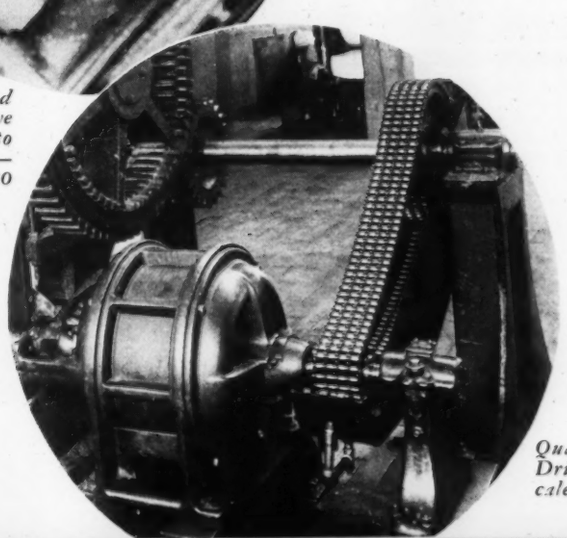
Diamond Chain insures the exact speed ratios between shafts—it can be run on either side—it permits working out your design in the most economical way.



Typical overhead line-shaft drive in Southern textile mill—Triple-strand Chain carries the well-known "Diamond" mark on every link.



Double-strand Diamond Drive from motor to spinning frame—installed over 10 years ago.



Quadruple-strand Diamond Drive from 30 hp. motor to 5-roll calender in finishing plant.

DESIGNERS of textile industry machines—have for many years found the use of Diamond Roller Chain aided in the design of their machines. They have adapted them as primary drives, from shaft to shaft or to a series of shafts—as part of conveyors—wherever motion is to be imparted from one member to another.

Use of Diamond Motor Drives Increasing Rapidly

In one bleachery, for example: *three* Diamond Drives were installed in 1927; *three* in '28; *17* in '29; *13* in '30; *13* in '31; *three* in '32; *six* in '33—the drives ranging from 5 to 100 hp.

In another, *three* 10 hp. drives have just been added—besides *1100 feet* of 1″ pitch chain with bent lug every six inches of conveying unit.

Another mill starting in 1932 with *two* Diamond Motor Drives (25 hp. at 1500 r.p.m.) on mangles has since added *15* more. Another starting with *24* in 1927 has since added *18* more. A finishing mill installed its first Diamond Motor Drive in 1926 and has added on *25* occasions since, in capacities from 3 to 40 hp.

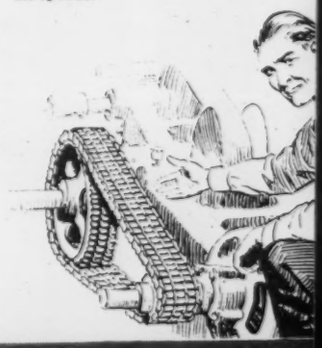
The installation of a few invariably leads to more, because the records show that Diamond Drives save power and last longer.

Catalog 583 contains information useful to both designers and production men. A copy will be mailed on request. Diamond Chain & Mfg. Co., 435 Kentucky Ave., Indianapolis, Ind.

Offices and Distributors in All Principal Cities

For the Production Men

The anti-friction roller bearing principle—the high maintained efficiency (98-99%)—mean reduced power consumption and lower power bills where Diamond Motor Drives are used. Single and multiple strands—for all speeds.



DIAMOND ROLLER CHAIN

ROLLING AT EVERY POINT OF CONTACT

CALENDAR OF MEETINGS AND EXPOSITIONS

Jan. 14—

National Association of Bottling Machinery Manufacturers.

Annual meeting to be held at Hotel Statler, Buffalo. Louis B. Montfort, 218 Munsey building, Washington, is secretary of the manufacturers association.

Jan. 14-18—

Society of Automotive Engineers.

Annual meeting to be held at Book-Cadillac hotel, Detroit, will include technical papers on "Suspensions and Car Structure," by M. Olley; "Transverse Leaf Independent Springing," by K. K. Probst, "Design and Development of Injection Apparatus for High-Speed Diesels," by C. R. Alden; and "Hydraulic Brake Actuation," by Burns Dick. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary of the society.

Jan. 18-26—

National Motor Boat Show.

Annual exhibition of boats, motors and equipment will be held at Grand Central Palace, New York, under the sponsorship of National Association of Boat and Engine Manufacturers. Ira Hand, 420 Lexington avenue, New York, is secretary of the association.

Jan. 22-25—

American Institute of Electrical Engineers.

Annual winter meeting to be held at Engineering Societies building, New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary of the institute.

Jan. 28-30—

American Society of Heating and Ventilating Engineers.

Annual meeting to be held at Hotel Statler, Buffalo, N. Y. A. F. Hutchinson, 51 Madison avenue, New York, is secretary of the society.

Feb. 17-22—

American Ceramic society.

Exposition and annual meeting to be held at Hotel Statler, Buffalo, N. Y. Ross C. Purdy, 2525 North High street, Columbus, O., is secretary of the American Ceramic society.

Feb. 18-21—

Technical Association of the Pulp and Paper Industry.

Exposition and annual meeting at the Waldorf-Astoria hotel, New York. R. G. Macdonald, 1 East Forty-second street, New York, is secretary of the technical association.

Feb. 18-21—

National Association of Coin Operated Machine Manufacturers.

Fifth annual coin machine exposition and annual meeting to be held at Hotel Sherman, Chicago, C. S. Darling, 120 South LaSalle street, Chicago, is secretary of the association.

March 3-10—

Leipzig Trade Fair.

International exposition to be held at Leipzig, Germany. Information may be obtained from Leipzig Trade Fair Inc., 10 East Fortieth street, New York.

March 5-8—

Packaging Exposition and Conference.

The fifth annual exposition and concurrent conferences and clinics on packaging, packing and shipping, sponsored by American Management association, is to be held at the Palmer House, Chicago. Management offices of the exposition are located at 232 Madison avenue, New York city.

March 12-14—

American Railway Engineering association.

Annual meeting and exposition to be held at the Palmer House, Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary of the association.

April 22-26—

American Chemical society.

Semi-annual meeting to be held at New York. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary of the chemical society.

MACHINE DESIGN

THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO

January, 1935 Vol. 7—No. 1

Design Refinements Feature 1935 Cars

By Austin M. Wolf

Consulting Automotive Engineer, New York

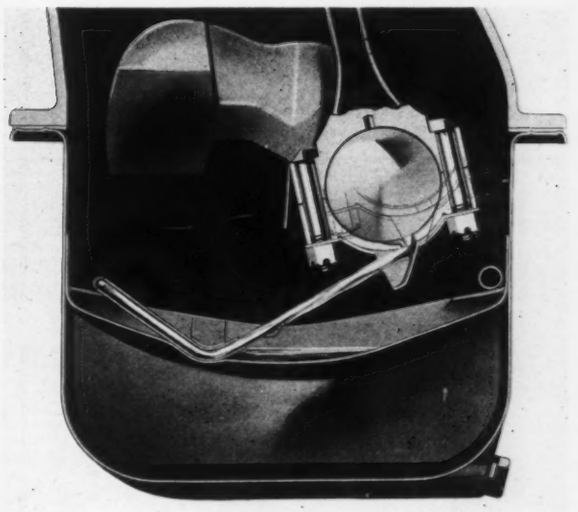


Fig. 1 — Trough splash lubrication system is improved by a nozzle in each trough which directs the oil stream into the path of the connecting rod dipper

AUTOMOBILE designs for 1935 indicate a desire to secure greater beauty and voluminous detail refinements rather than radical design innovations. The new cars show a wider adoption of some of the significant departures that were pioneered a year ago, namely, streamlined bodies and fenders, shifting of the engine weight forward, aluminum oxide piston coating, increased crankshaft counterweighting, superchargers, voltage control and ventilation of the generator, all-helical transmission gears, needle bearing universal joints, lower period front springs and quiet tire treads. A new standard of beauty is attained by a greater slant in windshields and rear body panels, more rounding roof contours, improved door curves and fenders which fit more harmoniously into the streamline ensemble. The V windshield and dual rear windows are in greater evidence.

The all-steel top is one of the important developments this year. It has been made possible by accoustical studies involving materials for sound absorption as well as insulation. In the Fisher body construction the seamless steel sheet runs back from the top of the windshield opening to include the entire rear window opening and extends over the sides including the drip moulding. Drumming is eliminated by padding placed between the top bows and the roof. A 3/16-inch deadening felt or compressed kapok fiber is used in different designs, being cemented to the under side of the metal. The other body panels are similarly treated. With the advent of the steel roof, the radio antennae is now a U tube mounted under the running board. It is usually suspended by rubber grummets which provide insulation as well as a flexible mounting.

A distinct advance in bearing metals following last year's introduction of lead-bronze is the new cadmium-silver copper alloy which can be made as a steel-backed replaceable liner for main or connecting rod bearings, or spun into the rod, being easily bonded or soldered. Silver alone added to cadmium makes it less susceptible to oxidation at casting temperatures,

increases ductility and counteracts the hardening tendency of the copper. Its ductility is valuable for thin-walled bearings. There is less likelihood of scoring with a soft shaft since the hardness demanded by lead-bronze is not needed. Cadmium-silver copper has a high factor of safety at elevated temperatures, greater inherent corrosion resistance and can be assembled with less running clearance than required for copper-lead, about the same as for babbitt.

With the practical standardization of the anti-knock value of the regular grade gasoline (between 68 and 70 octane number) by nearly all major oil companies, it has been possible to use high compression ratios without fear of running into detonation difficulties. Combined with well-designed combustion chambers it has now become possible to run up compression rates as high as 6.7-1, using cast iron cylinder heads. There is greater use of thermostats for controlling the circulating water temperature and pump capacity has been increased by a larger diameter rotor, more rotor blades or a higher rotor speed. Needle bearings are used on some of the pump shafts.

Many engines have increased oil flow through the engines with larger diameter oil lines. The Packard 12 has a Cuno full-flow filter with automatic cleaning, effected by variations in oil pressure through a piston operated ratchet. Chevrolet continues with the trough splash lubricating system. However, a nozzle in each trough pointing upward directs the oil stream above idling speeds into the path of the connecting rod dipper as it approaches and passes bottom dead center as shown in *Fig.* 1.

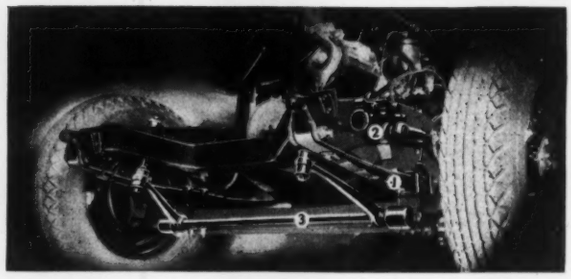


Fig. 2—Cross rod mounted directly on the front axle tends to "level out" the ride

This permits a longer period for oil reception and a higher pressure due to the velocity and direction of the dipper against the stream. The full length water jackets on the Plymouth and Dodge minimize cylinder distortion and aid in regulating oil temperatures. The Ford V-8 water jackets practically make a water jacketed crankcase. In all three the oil is kept cooler in summer and warmed up more quickly when cold.

The Auburn 8 supercharger is driven at six times crankshaft speed by a friction planetary step-up drive. Gearing is not necessary due to the light torque involved. Ground surfaces are used and the planetary "gears" are thin walled rollers.

Clutch springs are shrouded for almost half their length to prevent their bowing at high speeds. To reduce deflection losses, forgings are used at vital points and the cover stamping is more rigid. Adequate ventilation is provided by the triangular shape of the cover plate in one instance in which the side wall is interrupted, and in another case by incorporating 7/32-inch high radial ribs on the pressure plate to act as a blower for forced circulation. The Long clutch shown in *Fig.* 4 is distinctive in the use of integrally forged weights at the outer ends of the clutch release levers. Centrifugal

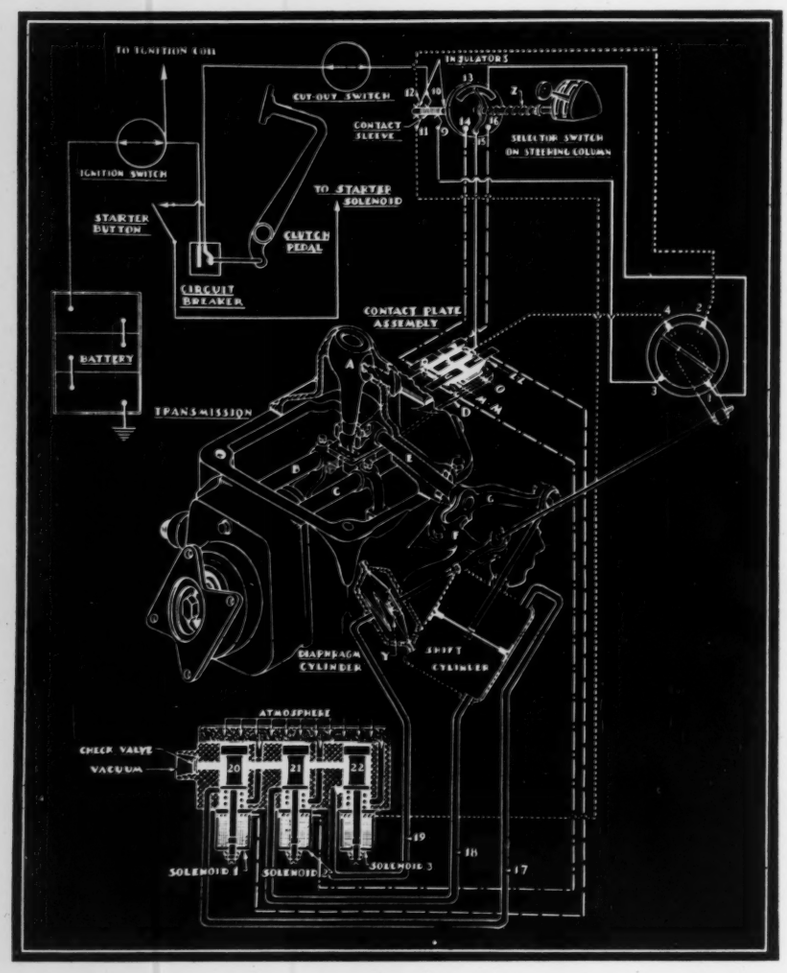


Fig. 3—A selector switch electrically connected with three solenoid valves controls gear shifting in new Hudsons

force gives the clutch a greater torque capacity at higher motor and slipping speeds and permits of lower spring pressure at normal operating speeds with resultant pedal pressure reduction. Friction in the levers is minimized by the use of needle bearings and a rolling contact at the lever fulcrums. A cushion spring drive with friction damping is incorporated in the driven plate hub.

Finger Control Offered

The most important transmission development is the "electric finger" control developed by the Bendix and Hudson companies, shown diagramatically in *Fig.* 3. A selector switch is mounted on the right side of the steering column within finger reach, comprising an H-plate with a small lever extending therefrom. This switch is electrically connected with three solenoid valves 20, 21 and 22 controlling vacuum to either side of a piston in the shift cylinder and to one side of a spring-pressed selector diaphragm, all mounted

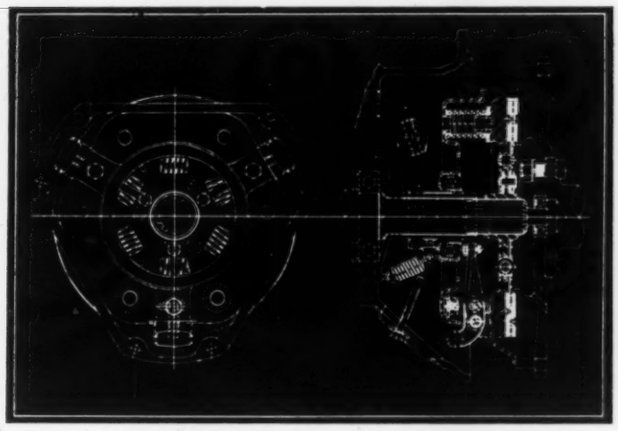


Fig. 4—*Centrifugal forces give this clutch greater torque capacity at higher motor and slipping speeds*

on the right side of the transmission. An interlock switch on the clutch housing actuated by the selector diaphragm and a contact plate assembly, the moving member of which travels in unison with the forward or backward movement of either transmission shifter-rod, are electrically connected with the selector switch and complete the equipment.

Preselection Is Possible

A circuit breaker is connected to the clutch pedal so that it is impossible to make a shift until the clutch has been disengaged. Current for the starter solenoid is also controlled by this contact requiring clutch disengagement before the starter control circuit is completed. Preselection is possible and the gear shift is made when the clutch pedal is depressed either with the foot or by the automatic clutch mechanism when it is employed. In the latter case the actual shift occurs when the foot is removed from the accelerator pedal.

Free wheeling and the automatic vacuum clutch control is used to a lesser extent. The overdrive introduced last year in the Chrysler and DeSoto is now extended to the Studebaker President and the large Nash. An overdrive of this type as used on the Chrysler was described on page 22 of the September issue of MACHINE DESIGN.

The hypoid rear axle is to be found on the Packard 120, the DeSoto Airflow and the Chrysler Airstream 8. Due to the below-center mounting of the pinion, it becomes unnecessary to place a tunnel in the rear compartment floor. The "sealed-for-life" rear wheel bearing has been adopted by a number of cars after its successful introduction last year by Oldsmobile.

Hydraulic Brakes Popular

Hydraulic brakes are in increasing favor, having been adopted by Studebaker, Pontiac and Packard 120. In the Plymouth, Dodge and DeSoto layouts, an interesting alteration is in the provision of a larger diameter piston in the wheel cylinder for the rear shoe. These shoes are rigidly anchored opposite the wheel cylinder and the front shoe obtains an energizing effect from the drum rotation when traveling forward which does not prevail with the rear. The variation in diameters thereby increases the effectiveness of the rear shoe.

There is an increasing use this year of the side sway eliminator which consists of a frame-mounted spring-steel cross rod behind the rear axle, with a lever extending forward to a link attached to each spring seat. This prevents rolling which would otherwise occur with the prevailing soft front springs. An innovation is mounting of this cross rod directly on the front axle, as shown in *Fig.* 2, depicting the Plymouth and Dodge construction and termed a "levelator". Rubber mountings are used to support

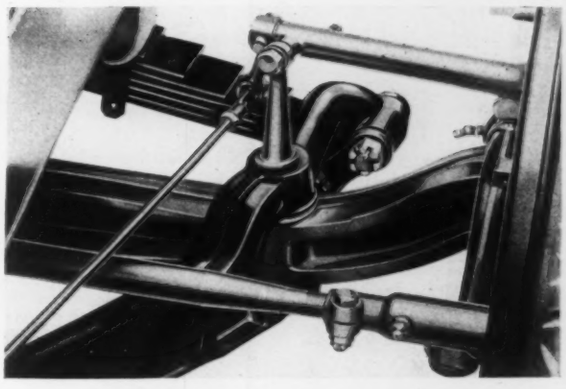


Fig. 5—*Spring on new cars is anchored to an integral forward extension of the radius rod*

each end of the cross rod, and the links extend upward to the frame with rubber cushion joints at each extremity.

The front Ford car and truck spring has been made longer and is located 4 inches ahead of the front axle. This permits the engine to be placed further forward, in excess of 8 inches over last year. The truck construction is shown in *Fig.* 5, and is similar to the passenger car in which the spring is anchored to an integral forward extension of the radius rod. Oilless bushings are used in the shackle.

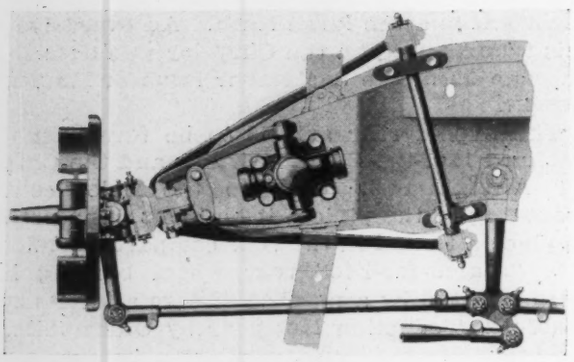
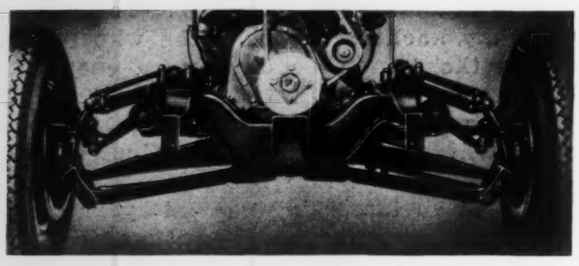


Fig. 6—Wishbone or parallel link type of suspension has been improved by use of a through-rod to anchor the lower wishbone

Fig. 7—Improved spring is shackled to each knuckle support, the lower end of which is pivoted from the frame



Parallel Link Construction Improved

The wishbone or parallel link type of construction, introduced last year, has been improved chiefly by the use of a through-rod to anchor the lower wishbone, as shown in *Fig.* 6, the DeSoto Airstream model. It will be noted that the side rail of the frame passes through the front cross member, and is a simplified construction over last year's offset side rail with the coil spring within the offset. The lower wishbone is directly anchored to the cross member and eliminates the previous "tray" that was riveted thereto.

A modified form of parallel link construction is used on the Packard 120 in which the lower wishbone is replaced by a single arm lever, the weight being transferred to it through a coil spring. This single arm and the upper wishbone anchored to the double acting shock absorber have their center lines reversed from the other parallel-link constructions in that the center lines extend at a slight angle to the rear instead of forward.

Spring Ends Positively Pivoted

Each of the lower arms is pivoted close to the center of the front cross member. The pivot axis is at an angle and intersects the anchorage of a ball-ended radius rod supported beneath the frame side rail. This rod extends forward and slightly outward and is anchored to the outer extremity of the single arm, close to its attaching point to the steering knuckle support. In this manner the wheel can rise and fall about the pivot axis. The radius rod takes all braking torque.

In the new Studebaker suspension a spring extends across the front of the car as shown in *Fig.* 7, in which it will be noted that the spring is shackled to each knuckle support, the lower end of which is positively pivoted from the frame by a stamped steel link beneath the spring. The upper connection from the steering knuckle consists of large diameter tube with welded-in end fittings. The outer fitting provides a needle bearing connection with the knuckle support and the inner fitting has widely spaced rubber-bushed supports at the top of the frame rail. Different lengths of upper and lower links provide the proper geometrical relationship so that there is no track change in 4½ inches rise of either wheel.

Jack Clamped to Bumper Bar

An interesting innovation is the new Chevrolet jack, which is clamped to either of the front bumper rear bars or to special seats on the rear bumper anchorage to the frame. The jack consists of a long, coarse-threaded steel shaft mounted with a slightly swiveling freedom in a stamped steel base. A bevel gear nut rides up and down the shaft when rotated by the handle and does the actual lifting or lowering. Other cars provide anchorage pads near the ends of the frame in order to overcome the difficulty of reaching under the axle in view of the overhanging body and fender designs now prevalent.

While there have been no revolutionary changes, it is apparent from the numerous engineering changes and detail refinements that there has been considerable activity in the design departments of the various manufacturers. It is this never ceasing desire for improving the product that has made the automobile the attractive, popular product which the public appreciates and desires.

SCANNING THE FIELD FOR IDEAS

DOMESTIC MACHINES KEEP PACE

STEADILY the trail of ideas embodied in industrial equipment and domestic appliances converges toward a common point. The goal of designers in these two distinct fields has been the same—increased production with less manual effort—but only in the past few years have they exerted a noticeable influence on each other. Both can afford to bring this liaison into even greater effect.

A specific case in which industry has set an example of what can be attained by applying such labor-saving power units as the thrustor is found in the new General Electric flatplate ironer, *Fig.* 1. Though widely accepted by industry since being introduced four years ago it was not until recently employed in a home appliance.

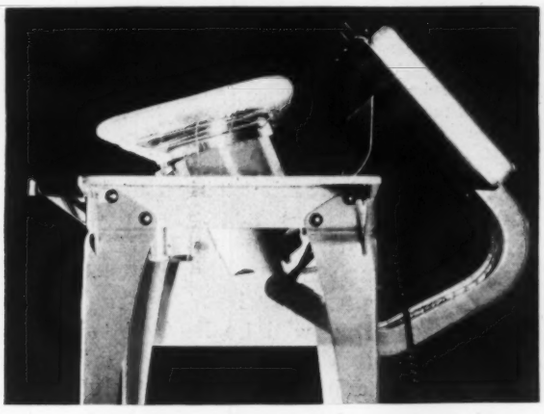


Fig. 1—Industry no longer can claim sole use of thrustor—it now is employed in this ironer

One advantage afforded by the thrustor is its ease of operation . . . a touch of the finger-tip control produces the required pressing force and provides a smooth return to the ironing buck to its open position. Because of the hydraulic action of the thrustor, uniform pressure is obtained regardless of the thickness of the material being ironed.

This device, consisting essentially of an hydraulic cylinder and piston actuated by a motor-driven pump, produces a powerful thrust motion which engineers in industry have found particularly well adapted to the raising and lowering of heavy loads and to other uses requiring a force to be exerted in a straight line.

The moment electrical input to the device ceases the piston falls because there is no longer any force exerted to sustain hydraulic pressure. Consequently, unless the padding is held deliberately against the shoe by some external means, the buck will drop by its own weight, thus protecting the material in the ironer against accidental clamping to the hot surface.

SCROLL THREAD PERMITS ADJUSTMENT

WIDELY divergent in their fields of application but similar in principle, the scroll chuck and a new adjustable plug piston present an admirable example of the transference and utilization of similar ideas. The piston, *Fig.* 2, is one of the most outstanding improvements in reciprocating engines for ships in recent years. A development of the American Ship Building Co., this plug piston can be adjusted conveniently to the minimum clearance without removal from the cylinder.

Adjustment is accomplished by loosening the adjusting plate, removing a small plug and inserting a pinion key which the operator turns

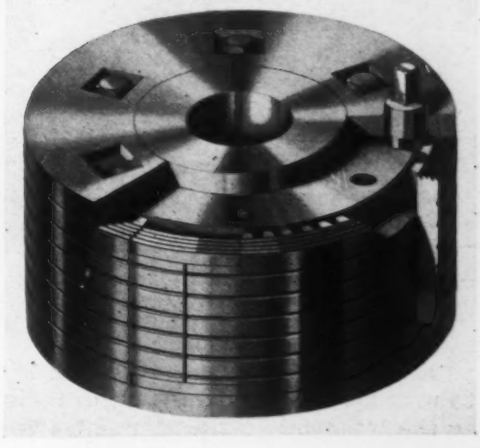


Fig. 2—Scroll thread controls the size of this piston which can be adjusted in cylinder

with a wrench. The pinion, engaging a rack, is turned until the feeler gage employed indicates proper clearance. Movement of the split ring for expansion and contraction is effected by means of right and left-hand spiral threads on the sides. When the proper fit is obtained the bolts in the adjusting plate are screwed down, the pinion removed and the plug replaced. Because V-threads are used the ring is held securely due to the friction created by this type of thread.

MOVING TAMPER WITH CONVEYOR

IN ADOPTING the automotive industry's production line methods in the manufacture of hollow bricks, engineers of the Dunn Mfg. company worked out an ingenious tamping or compressing head, *Fig.* 3, to utilize this idea. Material *M* is delivered to a conveyor chain from hopper *A* and thereupon is carried directly under the tamping head. Two hardened steel cams *B*, driven in proper timing with other functions of the machine by a roller chain *C*, exert direct force on tampers *D*. This places only a minimum load on arms *E* and *F* which act as guides for the tampers.

Automatic wear take-up for the cams and tamper rollers is accomplished through compression spring G located between the trowel arm *H* and tamper shaft *J*. Because the material is moving continuously in the direction of the arrow, tamper feet *K* must have a forward as

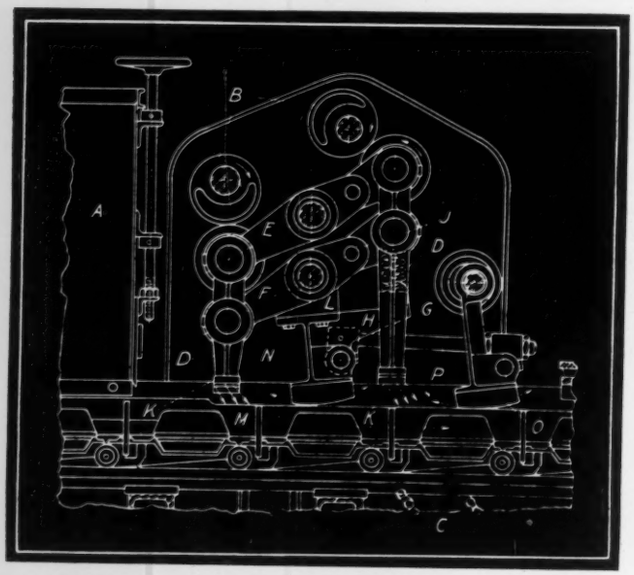


Fig. 3—Tampers actuated by cams follow movement of conveyor to compress ceramic material

well as a downward movement. This is necessary to prevent the tampers from dragging and tearing the material moving beneath them. The angular position of the tamper arms *E* and *F* which control the forward movement of each stroke of the tamper feet accomplishes this.

Driving trowel arm *H* is secured to boss *L* of tamper arm *F*, which imparts to it a swinging action, concentric with shaft *N*. Finishing trowel *O* is driven through a connecting rod *P* from *H*. Troweling produces a dense and water-resisting surface on the face of the bricks.

NOVEL USE OF SPRINGS IN BALANCER

EMBODIED in a new method for dynamic balancing of heavy rotating machinery in the field is an idea that deserves particular attention. In order to take full advantage of the new

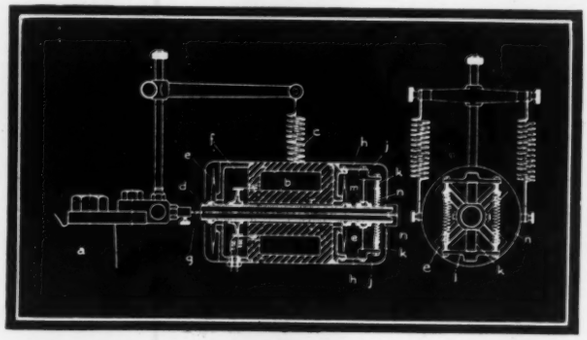


Fig. 4—Cross section through generator of dynamic balancer as mounted on machine pedestal

balancing method, for both high and low speed machines, instruments have been devised by E. L. Thearle of the General Electric research laboratory, by means of which vibration amplitude and phase angle can be measured accurately. This discussion will be limited to the principle employed in the generators, *Fig.* 4, a pair of which are attached to any two points such as the bearing pedestals of the unit to be balanced.

The main body of the generator is a permanent magnetic field structure *b*, annular in form and suspended by springs *c*. Central tube *d* is carried by two flat springs *e* which maintain rigid radial alignment but permit easy axial motion of the tube relative to field *b*. Tube *d* carries coil *f* in the gap of the magnetic circuit and is caused to vibrate with the machine pedestal by means of the slender rod *g*.

In order to maintain ruggedness of design the flat springs *e* must be so stiff axially that the natural frequency of vibration of coil *f* relative to the magnetic field would not differ sufficiently from the frequency of vibration of some low speed machinery. If this generator were used on low speed machinery the field structure would not remain substantially stationary in space and the motion of the coil relative to the field would not be a true measure of the vibration of the machine pedestal.

To avoid this difficulty, the mechanism at the end of the instrument serves as a "negative spring" to balance the positive stiffness of flat

springs *e* and thus lower the natural frequency of vibration of instrument without sacrifice of ruggedness. Notched blocks *j* are fixed to the magnetic field of the generator by means of flat springs *h*. Adjustable notched ring *m* is fixed to central tube *d* carrying the coil. The stiff struts *k* pivot in the notches of blocks *j* and the ring *m* and are loaded by means of adjustable springs *n*. An axial displacement of tube *d* and coil *f*, relative to the field, thus tilts the struts and introduces a "negative" restoring force, substantially proportional to the displacement. By adjustment of the tension in the springs *n* this negative restoring force may be approximately equal to the positive restoring force exerted by flat springs *e*, thus reducing the natural frequency of vibration of the instrument to a very low value and making it suitable for use on low speed units.

LUBRICATING BY CENTRIFUGAL FORCE

CENTRIFUGAL force has solved the problem of economically lubricating certain types of roller mill equipment. This type of oil lubricator, *Fig.* 5, was adopted to replace the grease reservoir which was unsatisfactory because of grease waste due to heat, and the time lost in renewing lubricant.

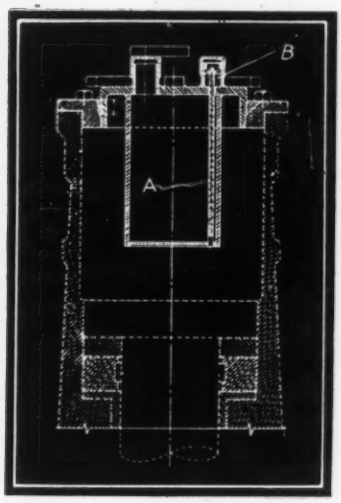


Fig. 5—Oil thrown by centrifugal force to the top of the metering tube is delivered to lubricate the roll journal while the mill is operating. Obviously, no oil will be supplied when the machine is stopped

The centrifugally operated device is installed in the upper end of the roll housing. When the mill is idle no oil is consumed, but as soon as the roll is set in motion centrifugal force throws the oil in chamber *A* to the top of a metering tube *B* located at one side of the oil chamber. Length and diameter of this tube is calculated to measure and deliver precisely the amount of oil necessary to lubricate the roll journal and its bearings. Thus it has been possible to meet the need for satisfactory oil lubrication of roll journals which formerly were designed for grease. This idea also has possibilities in other types of equipment, particularly where it is convenient to utilize the motion of one of the elements of the mechanism. Engineers of The Texas Co., New York, developed the unit.

IMPROVE DESIGN WITH NEW MATERIALS!

WHAT one manufacturer is doing in the choice of materials may be of assistance to designers confronted with similar problems. Take, for example, the casting of meat chopper bodies, worms and rings, spray heads, drain valve bodies and certain other miscellaneous parts of dish washers and potato peelers for which Hobart Mfg. Co. has standardized on nickel cast iron of the following analysis: Nickel 14 per cent; copper 5; chromium 1.25; manganese 1; total carbon 3.

From the standpoint of physical properties, castings made of the above analysis are much stronger than ordinary gray iron. Also they take a polish for chromium plating that cannot be obtained with ordinary gray iron castings, the company reports. Because the alloy is resistant to corrosion it is well adapted to dish washing machines and although it is more expensive than gray iron and more difficult to machine the company still finds it more desirable.

In *Fig.* 6 is shown the chopping end of a Hobart meat chopper. Ring and body are of alloy cast iron of the above analysis, as is the hub which projects from the perforated plate. These parts, after polishing and chromium plating are practically stainless. The feed pan is made of drawn steel, plated with chromium to produce a satin finish which closely matches the finish on the chopper body. The perforated plate on the discharge end of the meat chopper cylinder is made of cutlery grade stainless steel while the knife also is of stainless steel.

Through the use of these materials and methods the company has produced a meat chopper which retains its bright appearance over a period of years, as compared with the ordinary tinned cast iron chopper that had the habit of turning slightly green if not given proper attention.

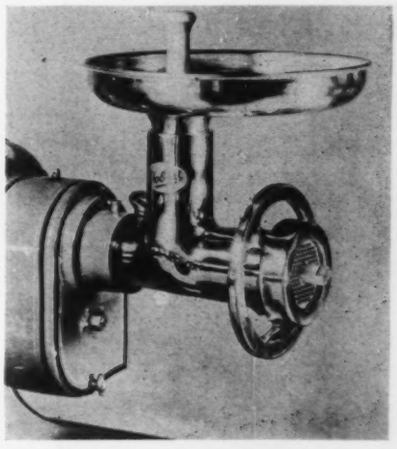


Fig. 6—Meat chopper made of nickel-copper-chromium-manganese alloy cast iron is stronger, takes high grade finish and chromium plating

Patent Infringement May Be By Careful Design

By George V. Woodling

THE INFRINGEMENT of a patent is analogous to a trespass, and constitutes a wrong upon the intangible property rights of the inventor. In applying the test of infringement, the courts examine two things: One, did the alleged infringer commit an act of trespass; and, two, if he did commit the act of trespass, did the trespass take place upon the inventor's property or upon public property, in which case there is no liability?

Usually there is substantially no difficulty in deciding whether or not the alleged infringer committed a trespass. The patent statutes are quite clear on this point in that they state an evasion of a patent right may occur in any one of three ways: Unauthorized manufacturing; unauthorized selling; or unauthorized use of the patented invention. The greatest difficulty arises in deciding whether or not the trespass occurred upon the inventor's property. The patent statutes are not clear upon this, leaving it for interpretation by the Federal courts.

It is important to keep in mind that in order for the patentee to sustain a charge of infringement he must show the alleged infringing structure lies within the territory bounded by the fence of the claims of his patent. In other words, even though the accused device looks substantially like the device shown and described in the plaintiff's patent, there is no infringement unless the plaintiff's claims are violated. It is the *claims* of a patent which are infringed, and not the structure shown in the patent drawing. This is an important distinction to keep in mind. Frequently executives refrain from manufacturing and selling a clearly noninfringing device which they have a perfectly legal right to make and sell, because they feel that the proposed device looks like the structure shown in the patent drawings. Despite these facts, the drawings and the patent description do have a bearing on the question of infringement. They serve as a "dictionary" for the claims, and thus aid the court in interpreting the claims of the patent in their proper light.

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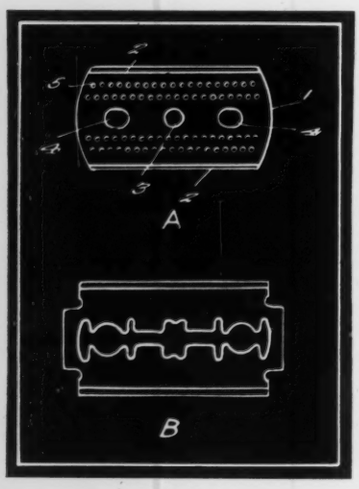


Fig. 1—The omission in B's blade of the small holes avoided the infringement of the claim of A's patent

Example Number I

As a typical case of litigation which covers a principle often encountered in machine patents, let us cite the following. The plaintiff owned the patent covering blade *A*, shown in *Fig.* 1, and sued the defendant for the unauthorized manufacturing, selling and using of blade *B*. Plaintiff conceived the idea of taking a Gillette type of safety razor and fitting it with a lock for shifting the blade in either the shaving or nonshaving position. When in the locked position the razor blade could not be used for shaving or for any other purpose. Along with the creation of the "locked" razor, the plaintiff invented a special blade. The plaintiff's razor was primarily developed for inmates of jails and asylums. The blade was made flexible or fragile by a multiplicity of closely arranged apertures adjacent to each of the cutting edges, so that in the event an insane person tried to unlock the razor by picking the blade with an instrument, the blade would break into many fragments and render it unfit for use.

It is with this blade that we are concerned. The plaintiff's claim for the blade reads:

"As a new article of manufacture, a transversely flexible razor blade having a sharpened edge and also having *ad-*

Avoided

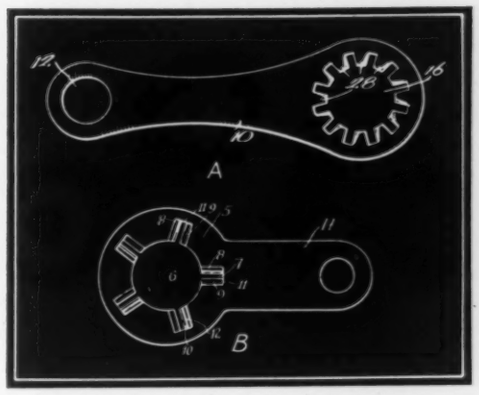


Fig. 3—A change in the exact form of teeth in the electrical connector at B enabled the inventor to avoid infringement

jacent to said edge a *multiplicity* of minute, closely arranged apertures."

The plaintiff urged a broad construction of his claim because he realized that such a construction was essential to prove his case. He predicated his charge of infringement upon the broad principle that the long slot in the defendant's blade made the blade flexible, as provided by a multiplicity of closely arranged apertures. The court, however, placed little importance upon this feature of flexibility, but gave special attention to whether or not the defendant's razor blades came within the scope of the plaintiff's claim. The court pointed out that the plaintiff's claim contained four definitely limiting words, or phrases, namely: multiplicity; minute; closely arranged; and adjacent.

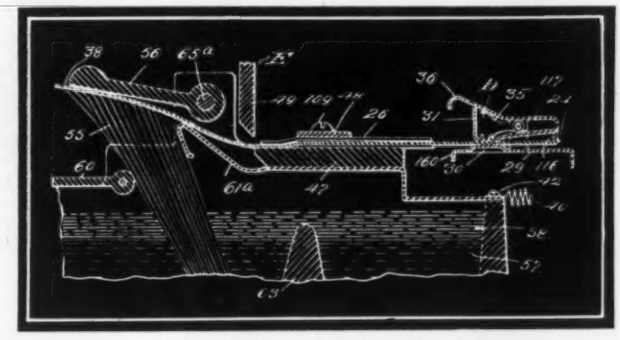


Fig. 2—Reversal of brush and weighted flap does not constitute an omission

None of these limitations can be found in the defendant's blade. Therefore, the defendant's blade does not lie within the territory bounded by the scope of the plaintiff's claim. The plaintiff having specified the number, size, relationship and function of the elements of his claim, he cannot be permitted to depart from the plain meaning of the language used in the claim, and seek a broader construction. Therefore the court held that the manufacture, sale, and use of the defendant's razor blade did not constitute an infringement of the patentee's claim. Thus with a few possible exceptions (examples of which are given in the following), it may be stated as a general rule that there is no infringement if the defendant's device *omits* at least one of the limiting provisions of the plaintiff's claim unless an equivalent is substituted for the omission. This may be referred to as the "omission" test.

Example Number II

This next example brings out the fact that a charge of infringement is not necessarily avoided by changing the relative positions or the reversal of the parts of a machine where the parts transposed perform the same functions after the change as they would before. The plaintiff who owned the patent covering a tape serving machine, *Fig.* 2, alleged that the manufacture, sale and use of the defendant's device constituted an infringement of the claims of his patent. As shown in *Fig.* 2, the plaintiff's device related primarily to the combination of brush 55 and weighted flap piece 56 for moistening the gummed paper tape as it is delivered from the mechanism. In machines of this type the gummed tape is pushed through the unit from the rear. Therefore, the action of brush 55 and flap piece 56 must be such as to offer the correct pressure as the gummed tape passes between them. If there is too much pressure between the brush and the flap piece the tape will buckle and cannot be pushed through. If there is not sufficient pressure, or total absence of pressure, the brush will bend away from the flap piece, thus breaking the contact and thereby causing the brush to dry out, resulting in the failure of the moistening function. The patentee claimed:

"In combination, a device for applying moisture to a tape, including a brush and a *pivoted weighted member* resting freely on said brush for forcing the tape into contact with a moistened surface of said brush."

The defendant's construction, instead of using a fixed brush and a *pivoted weighted member* as set forth in the plaintiff's claim, used a fixed member with a *pivoted brush* urged upwardly against the fixed member by means of a spring. This construction is merely the reverse of the plaintiff's design and, literally speaking, the defendant's device avoids the claim of the patentee when applying the "omission" test. The court,

however, held that notwithstanding the reversal of parts, there was an invasion of plaintiff's rights. This, in effect, constitutes one of the exceptions to the "omission" test.

Example Number III

Pioneer inventions are entitled to a broader range of equivalents than the "so-called" improvement inventions. In other words, the range of equivalents covered by the claims of a patent corresponds with the character of the in-

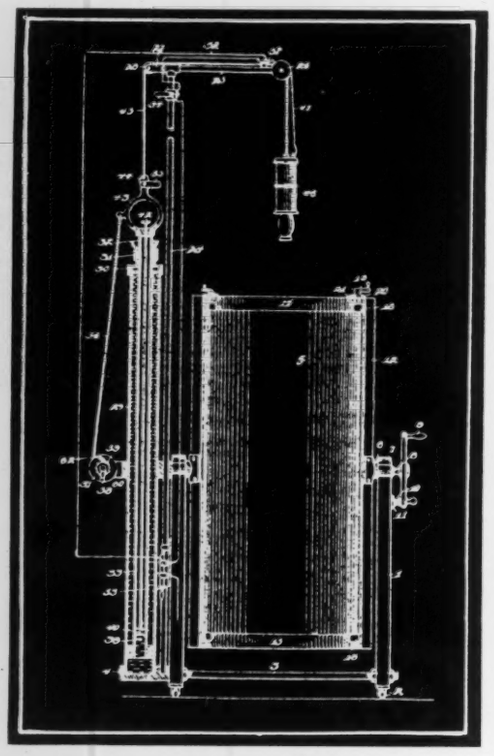


Fig. 4—Even though the machine in Fig. 5 has additional features, the patent of this machine controls the manufacture, use and sale of that later design

vention. However, the mere fact that an invention is secondary does not alter the provision that the patentee should not be denied the benefits of the "doctrine of equivalents" necessary to protect his actual invention, even though the invention may reside in a very crowded field.

In this example the plaintiff owned the patent covering the electrical connector shown in *Fig. 3A*, and sued the defendant for the unauthorized making, selling and using of the electrical connector *B*. The plaintiff's electrical connector was provided with a series of teeth 28 with substantially square ends. These inwardly projecting teeth are twisted, so that one corner of each tooth projects upwardly and the other diagonally opposite corners downwardly from the plane of the connector, whereby, when the nut is set, the projecting corners of each tooth presses against and digs into the contacting surface, preventing the nut from becoming unscrewed. One of the plaintiff's claims was:

"An electrical connector of conductive material having a terminal shank and an end with teeth which are substantially square ended and warped so as to form two *angular corners*, one above and one below the plane of the plate for insuring electrical contact and preventing accidental loosening of a binding screw or nut by rotation of said shank."

As shown in *Fig. 3B*, the defendant's device is provided with slits 7 extending back from the inner circumference of hole 6. The metal 8 along one side of the slit projects upwardly and the metal along the other side of the slit projects downwardly from the face of the connector, so that, when the nut is firmly set, the sharp projecting edges prevent the nut from becoming loose. The operation of the defendant's device is substantially the same as that of the plaintiff's. In applying the "omission" test it is noted that defendant's device does not have "teeth which are substantially square ended and warped so as to form two angular corners", as specified in the plaintiff's claim. Notwithstanding this omission, the plaintiff contended that he was entitled to a "range of equivalents" to bring the defendant's device within the scope of his claim.

In analyzing the prior art, the court found that the only possible variance which the plaintiff shows over the prior patents is the peculiar twist in the teeth to prevent unscrewing of the nut. In view of this small improvement, the court held that the plaintiff was not entitled to a "range of equivalents" sufficiently broad to include the defendant's device, at the same time pointing out that if the plaintiff's patent were a pioneer invention it might cover the defendant's device as well as other forms of edges which might be raised from the plane of the connector to resist the unscrewing of the nut when once it is set. Therefore, it can be observed from Example 3 that when analyzing the question of infringement it is necessary to have a search made of the prior patents to determine the character of the plaintiff's invention. Should the patent reside in a crowded art a condition arises where, if the patent were accorded a "range of equivalents" sufficiently broad to cover the accused device, the patent is invalid, but if limited to the patentee's structure, there is no infringement.

Example Number IV

Before a manufacturing concern expands its business to include a new field, or before it embarks upon the exploitation of a new device, it is a good plan to investigate the patent situation to determine if the proposed device is free of infringement. This may be done by conducting a search in the Patent Office to find all of the pertinent patents relating to the proposed new device. In some cases, the search may re-

veal as many as one hundred patents which appear to be relevant. Each of the claims of these patents are then analyzed separately to determine whether or not the proposed device is a noninfringing one. Such a search and study entails a great deal of work and a considerable amount of expense. In addition, even though the search and study is a complete one, there is always a possibility that there might be a patent which was overlooked, yet one which is infringed by the proposed device. Then too, even though such a search is complete, it may not be final as each week there are newly granted patents which may be infringed by the device.

In some cases the commercial value of the proposed device may not warrant such an extensive search and study and, in this event, the only sure way to avoid infringement is to construct the proposed device substantially in accordance with some expired patent. This is what the defendant did in the following example. Of course this practice cannot always be recommended, because in many cases the devices of an expired patent are usually obsolete.

Claim Defines Design

With reference to *Fig.* 6, the three illustrated views are a diagrammatic showing of the drop doors of a ballast railway hopper car. In this example, the owner of the patent covering the device *C* sued the defendant for the manufacture, sale and use of the accused structure in *B*. The controversy concerned principally inner doors 2 of the hopper on each side of center sill 1, through which the ballast from a hopper is dropped upon the road bed between rails 3, without flooding the tracks. Doors 2 in the plaintiff's patent are hinged at apexes 5 of the hoppers and, when the doors are closed, their inner edges are relatively close to each so that in the opening of the doors the ballast does not begin to flow until the inner ends of the doors begin to separate, as shown by dotted line 4. This prevents the ballast from flooding the rails, as shown by dotted line 10 which indicates the general outline of the ballast after it is dumped between the rails. One claim reads:

"A car of the class described having a center sill, a substantially V-shaped hopper on each side of the center sill, and doors mounted for swinging movement about longitudinally extending axes at the apexes of the hoppers, said doors extending from their hinging axes toward the center sill and being of a length sufficient to cause their swinging edges to remain *adjacent to each* other and *prevent material flowing* between them in any substantial quantity until said edges are substantially in the planes which define the angle of repose of the deposited material resting upon the base below the tops of the rails."

The defendant, in order to construct a noninfringing device, constructed his hopper car substantially in accordance with the expired patent *A*, *Fig.* 6, except for the minor detail of having center sill 1 exposed to the inside surface of the hopper car. In applying the "omission" test, it is noted that the defendant's structure does not infringe the plaintiff's claim, because the structure does not include the provision, as specified in the plaintiff's claim, of doors being of a sufficient length to cause their swinging edges to remain adjacent to each other and prevent material flowing between them in any substantial quantity until said edges are substantially in the planes which define the angle of repose of the deposited material resting upon a base below the top of the rails. In cases where the defendant makes his device in accordance with an expired patent, there is no chance of the plaintiff recovering on a charge of infringement.

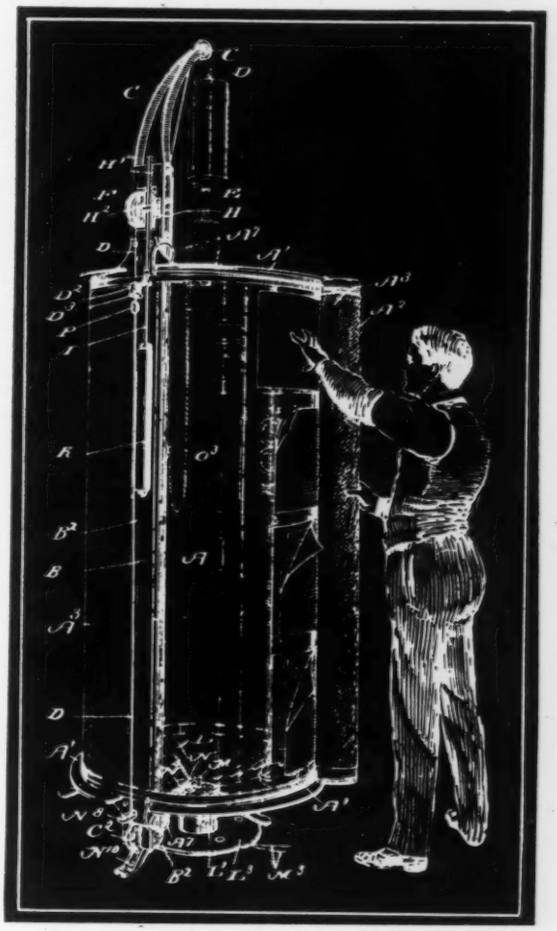


Fig. 5—An addition made to the machine does not avoid infringement of a prior patent

Example Number V

Sometimes the defendant feels that he can avoid a charge of infringement if he obtains a patent upon his own device covering the additional features that his device possesses over the plaintiff's device. This is an erroneous idea because a patent does not give the inventor the

right to make, sell or use his own device if it infringes a prior patent. The grant of a patent gives the inventor only the right to exclude others from making, using or selling his device.

In cases of this nature the defendant usually brings up the argument that the structure of his own device does not infringe the claim of the prior patent because the Patent Office, in granting him the patent, declared that his own device was patentably different from that shown in the prior patent. But, while there may be a patentable difference, the claims of the plaintiff's device may be broad enough to include the construction of the defendant's device even though the defendant's device includes new features or improvements over the plaintiff's device. In examining the defendant's patent application the Patent Office has no concern with the scope of the plaintiff's claims, and does not and must not pay any attention to the fact that the plaintiff's claims cover the defendant's device. Therefore, a patentable difference does not of itself negative infringement.

Additional Features Included

A case illustrating this point is found with reference to *Figs.* 4 and 5. The plaintiff, the owner of the patent covering the device in *Fig.* 4, sued the defendant for infringement by the device of *Fig.* 5. It was found by the court that the defendant's device included substantially all of the features of the plaintiff's device, and the mere fact that the defendant's device included additional features and improvements did not free the defendant of the charge of infringement. In other words, the "addition" test does not avoid infringement.

It must not be understood from the foregoing that it is of no importance to obtain a patent upon additional improvements, because sometimes it means that even though the plaintiff has claims which cover the defendant's device the plaintiff cannot manufacture, sell or use the additional improvements claimed in the defendant's device without infringing the defendant's claims. This puts the defendant in a good position to bargain with the plaintiff for a favorable license in exchange for a cross license.

Aside from the rules in the foregoing examples, there appears to be somewhat of an exception when it is found that the defendant's activity in making his device was certainly stimulated by the plaintiff's trade announcement of the completion of his device and the defendant's device was made after inspection of the plaintiff's machine and copied substantially the same general principle, yet made a colorable evasion of the plaintiff's claims. In cases of this nature the courts are somewhat inclined to give a rather flexible interpretation to the claims in order to hold the defendant responsible, even though the accused structure lies without the boundary of the territory covered by the claims of the plaintiff.

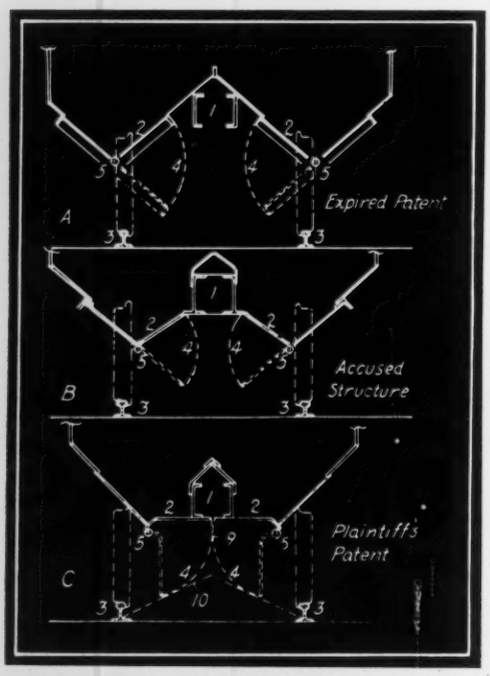


Fig. 6—Design at B which followed an expired patent avoided infringement

Must Remember Exceptions

When designing noninfringing devices or machines the designer must keep in mind not only the omission test but also the exceptions as well. The omission test, as set forth in Example I, may be considered as the universal test of noninfringement, for the reason that when there is an omission of at least one of the limiting provisions of the claim in question in an existing patent the new combination is not the same as the old combination as set forth in that claim. This is true provided that an equivalent has not been submitted for the omitted provision.

In view of the fact that the mere reversal of parts as explained in Example II, or the stimulation of activity by inspection of the plaintiff's prior development constitute exceptions to the omission test, the designer should not feel too optimistic when making a mere colorable evasion of the claim in question in a prior unexpired patent, but should assume the attitude of a constructive pessimist. With this attitude the designer will not feel satisfied until he has designed a clearly noninfringing device.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Careful Research Obviates Patent Pitfalls," March, 1933, p. 25; "Value of Patent Depends upon Efficient Claims," Aug., 1933, p. 13; and "Protect Your Right to a Valid Patent!" Nov., 1933, p. 24; all by George V. Woodling.

"Outstanding Patent Book Revised," Feb., 1934, p. 23.

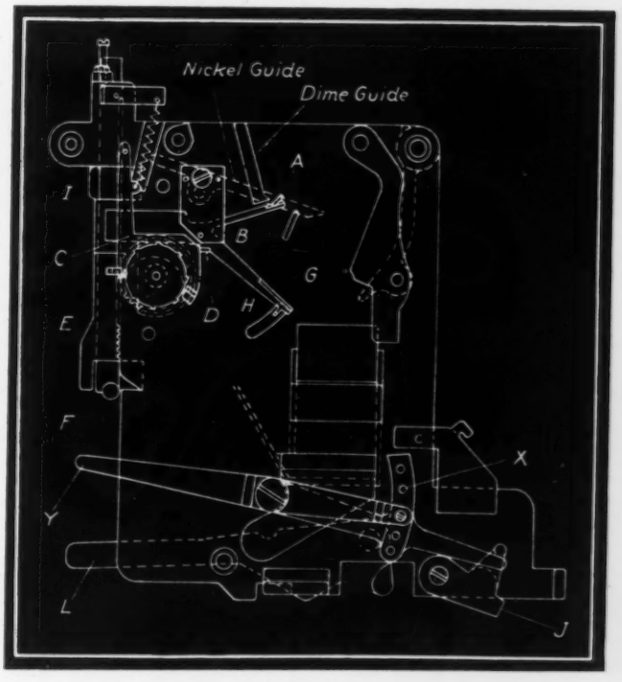
"Patent Contracts Insure Legal Protection," April, 1934, p. 29; "Patents Should Be Prepared with Care But Without Undue Delay," July, 1934, p. 24; "Pitfalls Await the Unwary in Assigning Patents," Sept., 1934, p. 15; and "Sales Value of Appearance Can Be Protected," Nov., 1934, p. 15; all by George V. Woodling.

Foolproof Devices Protect Coin Machine

By Harold B. Veith

Fig. 1—(Above)—Design of this cigarette vending unit embodies 85 die castings

Fig. 2—(Below)—An escapement mechanism operated by coins controls the unlocking of the plunger mechanism, Fig. 5



INCREASING popularity of die castings as machine parts is due fundamentally to the savings that can be made through the use of this manufacturing process. Examination of any intricate casting reveals that the cost of fabricating such a part by machining or stamping would be prohibitive, even if practicable as a single unit. These were the major factors that influenced the use of die cast parts in the design of the Rowe cigarette vending machine, *Fig.* 1.

Eighty-five zinc die castings, one of the most extensive applications of this type of part in any single machine, are employed. The front and side frames, *Fig.* 3, exemplify probably the largest area of thin wall section—0.050-inch—ever attempted in the industry. These side members also are outstanding cases of a combination of parts being united to form one piece. Bosses, ribs, lugs, coin passage-ways and a structural frame make up the composite member.

High Casting Pressure Employed

The two side frames are produced in a combination die requiring a casting machine with a die tension capacity of three-quarter million pounds. Metal is forced in the molds under extremely high pressure in order to fill the remote sections of the thin walls and the details of ornamentation, as well as to provide the structural strength and rigidity required.

Perhaps the more interesting use of die castings in this machine, however, concerns the coin-operated mechanism for delivering a package of cigarettes after the stipulated number of coins has been deposited. From the standpoint of ingenuity in designing a foolproof mechanism this unit is particularly noteworthy. In vending machines it is of course necessary to protect the machine against dishonest operators. This is accomplished by various features discussed in the following paragraphs.

The operating unit installed in the right-hand

side of the case, *Fig.* 4, consists of three separate assemblies, the scavenger, slug ejector and the register shown in *Fig.* 2. Purpose of the scavenger is to guard the machine against materials and metals such as undersized disks, matches, hairpins, bent and distorted coins, etc. To accomplish this a coin race on each side of the machine, one for dimes and one for nickels, is made only a few thousandths larger than the diameter and thickness of a dime and nickel respectively. Anything larger or thicker than these two denominations will stick in the races. In order to clear obstacles from the raceways the designers have provided hinged flaps operated through the coin return plunger (the last one to the right, *Fig.* 1). When these flaps swing outwardly the obstacles fall into the coin return chute. To obviate wear, certain sections of the coin passageways are chromium plated.

For preventing spurious coins that are undersize from reaching the coin register, balances pivoted on pins are placed in the coin paths of the slug ejector. As those of correct size pass over the balances they slow down and pass into the register. Undersized spurious coins travel over the end of the scavenger race and are returned through the coin return route. On the nickel side of the scavenger, soft metals such as lead are slowed down by friction created as the coin comes in contact with a flat spring, and thus are rejected.

Magnets Make Final Selection

In machines of this type the designer must also take into consideration the chemical analysis of the coin. Although slugs may correspond to nickels or dimes in weight and size, they must be of the correct analysis to progress through the proper channels. A magnetic field solved the problem of making this final selection between spurious and genuine money.

The first magnetic member to act upon the coin is a bar magnet which determines the steel or iron content of the coins. If attracted by the comparatively weak lines of force at this point, the coin comes into engagement with the rounded end of the bar magnet and is directed into the coin return chute in the base of the machine. Although the magnetic field attracts the metal disk to some extent the momentum gained in the downward course is sufficient to prevent it from lodging there.

Those spurious coins that may be able to pass the bar magnet must later go through a stronger magnetic field created by horseshoe type magnets, *Fig.* 4. These parts are made of alloyed cobalt steel, and although they weigh but two ounces they are able to lift twenty-seven pounds. As the illegal slugs are subjected to this magnetic field their momentum is retarded in varying degrees according to the magnetic conductivity of the various metals or alloys.

Speed of Nickel Is Faster

Speed of a nickel because of its alloy content is retarded less than most other slugs or coins. Therefore when leaving its magnetic area the nickel travels at a greater speed and drops at a higher angle, thus causing it to go over an abutment and into the money register. Other disks, being retarded, pass below the point and are deflected in a different direction into the slug raceway.

In the two chutes, for nickels and dimes, it was found necessary to use two magnets on the nickel side and one on the dime side in order to compensate for the influence of weight variation. Nickels being much heavier and also possessing lower magnetic susceptibility than dimes, necessitate the application of a much stronger magnetic field.

Dimes, in traveling down the coin guide, *Fig.* 2, from the magnetic device, contact coin-counting lever *A*. This part, made of brass, is pivoted at *B*. When the coin strikes the upper arm of lever *A* the impact actuates it sufficiently to move the floating ratchet escapement *C* which is pivoted at *I*, by contact between the two parts at point *D*. Ratchet wheel *E* thereby is permitted to turn one notch, allowing rack *F* to drop a short distance by gravity. It is prevented

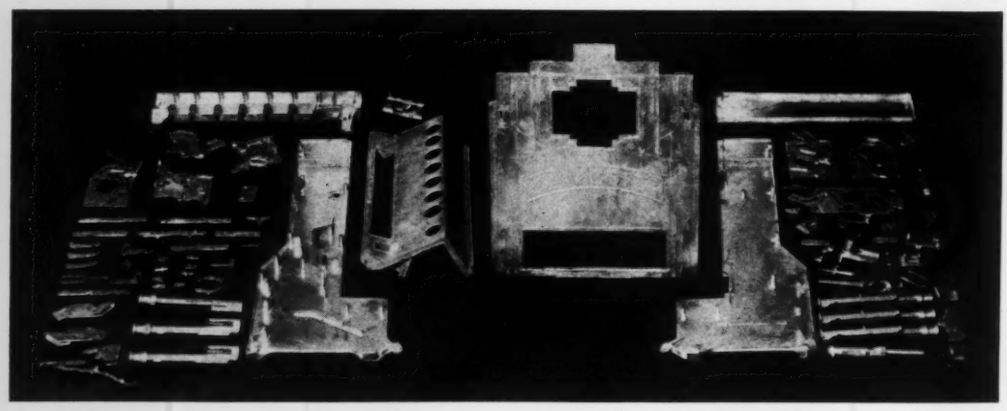


Fig. 3—*Some of the die cast parts comprising the vending machine. The intricacies of their design offer evidence of the wide possibilities of the process by which they were produced*

from dropping more than the equivalent distance between notches on the ratchet wheel by a gear attached to the wheel. As the dime progresses downward it strikes another arm *G* of lever *A* and the ratchet wheel again turns to allow the rack *F* to drop the equivalent of another notch. The reason for the double movement of the ratchet is explained in the following paragraph.

Lower arm *G*, *Fig.* 2, of the coin-counting lever *A* extends also through a curved slot in the register body into the nickel race on the reverse side of the main plate. When the nickel, after passing through its magnetic field, strikes the extended arm *H* the same action occurs as with the dime, except that only the lower arm is contacted by the nickel. In other words it takes two nickels to move the rack *F* a distance equivalent to that effected by a dime. This arrangement allows the customer operating the machine to use any combination of these two denominations. When the rack *C* has dropped its maximum distance, as ordained by the price of the cigarettes, it raises locking pawl *J* by forcing down lever *Y*.

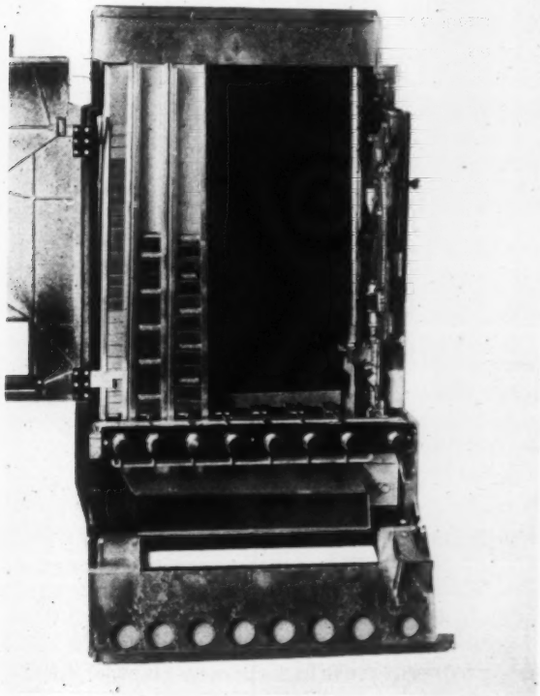


Fig. 4—Coin-operated mechanism of the vending unit is shown at right-hand side of case

When pawl *J*, *Fig.* 2, has been lifted out of slot *K*, *Fig.* 5*a*, a delivery plunger such as *L* can be drawn forward inasmuch as segmental bar *M* can move to the right because it no longer is restrained against movement through crank member *Q*. As shown, one arm of the crank member abuts a raised portion on operating bar *R* in which slot *K* is located.

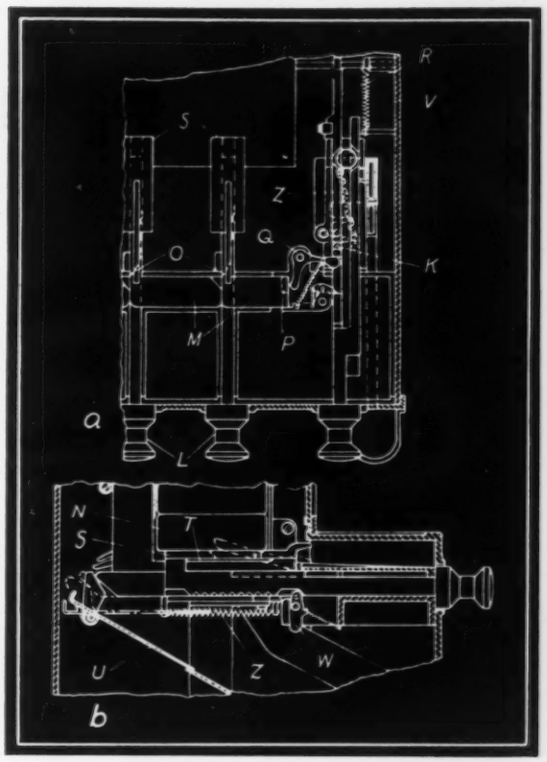


Fig. 5—Plunger mechanism incorporating foolproof devices is installed horizontally in base of machine

Segments *M* are interposed between each plunger *L* and are designed with a rounded corner to allow cam *O*, an integral and raised part of each plunger, to move to the right the segment it contacts. When the cam is wedged between any two segments *M* the paths of the cams on the remaining plungers to the right of the withdrawn plunger are blocked. Segments to the left are held against separation by the abuting of a segment against the adjacent raised portion of the cam on the withdrawn plunger. This of course interlocks the plungers and allows only one pack of cigarettes to be obtained unless more coins are dropped.

A steel insert at point *P* in segmental bar *M* obviates wear, this being common practice in die castings where there is sliding action. As operating bar *R* is moved through the action of the segmental bar and crank member *Q* a coin distributor shelf swings away to permit the money to drop into the coin box. Coil spring *Z* is provided to return the bar *R* to its original position.

When the plunger platform *S* is moved from under the cigarette package *N* the tiered packages move downward, the lowermost pack resting on a pair of side flanges *T*. As plunger *L* is moved inwardly the rear of platform *S* engages the front end of the lower package and moves it out of the hopper and off flanges *T*

(*Concluded on Page* 69)

Bearing Analysis Determines Permissible Speeds

By William A. Rowe

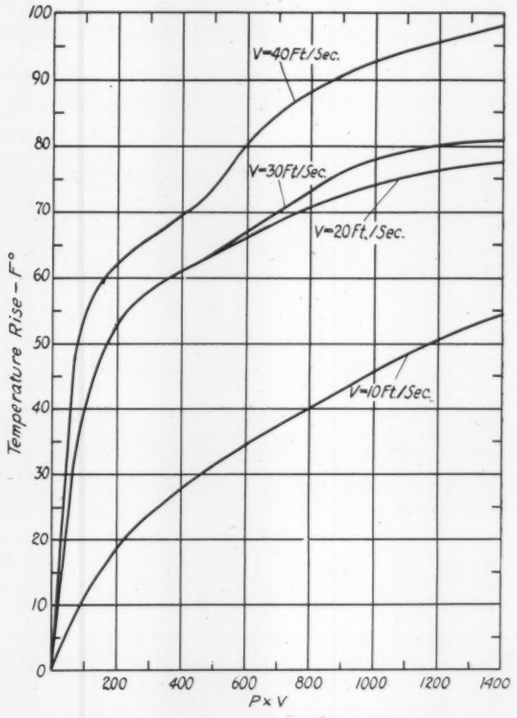


Fig. 2—Chart shows tendency for rapid rise in temperature as velocity increases

IN THE December 1934 issue of MACHINE DESIGN appears an interesting and instructive article on "Reaching the Limits in Bearing Performance", by H. B. Dexter. To one who has had to meet this problem in the everyday application of ring-oiling bearings, the extent to which it is possible to go by the exercise of proper care and the use of mechanical systems of oiling is, to say the least, most enlightening. In the field of advanced machine design it may be necessary for the designer to approach those limits frequently. There are, however, other fields of application which require much more conservative practices. I refer, for example, to transmission, electrical machinery, centrifugal fans and pumps, etc. Here ring-oiling bearings are most frequently encountered. The wide extent of this group and the almost universal use of the ring-oiling bearing justifies an investigation of its own, and the establishment of rational practices suited to its particular needs.

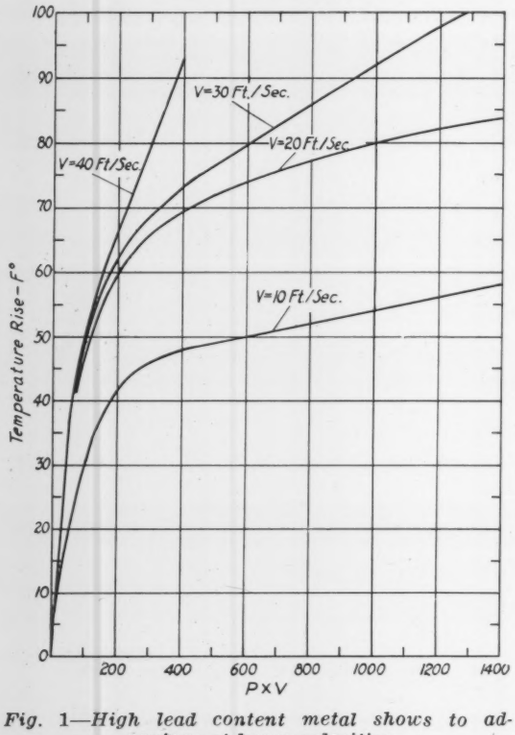


Fig. 1—High lead content metal shows to advantage at lower velocities

For many years the writer was concerned with the application and design of centrifugal fans and blowers. In this field antifriction bearings are rapidly coming to the front. Nevertheless the ring oiling bearing has wider application.

When the problem of design limits arises one is somewhat perplexed over the wide differences of authorities on safe limits of operation. This may possibly be only a reflection of equally variant practices in both the design and workmanship encountered therein. We still find bearings with utterly no attempt at finish. Then we see some cases in which the bearing has been given begrudgingly a most cursory machining. Lastly we have the welcome example of a really finished job.

In the matter of design, we find prevalent the use of open ring spaces in the lower half of the bearing, so that solid rings can be used. In this type most of the oil which is brought up to the revolving journal immediately finds its way back to its source. Continuous successful operation is only likely where limits of pressure and velocity are very low. It is probably for

such as these that the limits of $P \times V = 360\pm$ was intended, where;

P = unit pressure per square inch of projected area
V = velocity of journal surface in feet per second

The assignment of such low limits apparently not only presumes, but seemingly invites, metallic contact of the bearing surfaces, and seems oblivious to such details as maintenance of oil film or freedom from wiping.

It would seem almost axiomatic that continued operation requires continued maintenance of an unbroken oil film. To secure that result in anything but the easiest service, the lower half of the bearing should have the ring spaces bridged and snap rings used. The oil wiped from the shaft by the bridging is distributed along the length of the journal by means of a generous relief at the side joints. No other grooving is needed, or desirable.

With this specification complied with, and with care exercised in the finish of the bearing surface, we achieve a condition where $P \times V = X$ no longer applies, unless for X we can intelligently assign as many values as it would be possible to obtain through the principles of permutations and combinations. This is because the value of X depends on several factors, for example: Excellence of bearing finish; material used for bearing; unit pressure; surface velocity; and lubricant characteristics.

Simple Investigation Made

In an effort to find a better answer to this question the writer undertook several years ago a simple investigation, the results from which were so gratifying that they are presented herewith.

To start with, we were using three different metals for our bearings. One was 75.7 per cent lead, 11.6 per cent tin, 12.2 per cent antimony, and 0.5 per cent copper. The second consisted of 50.0 per cent lead, 38.0 per cent tin, 11.5 per cent antimony, and 0.5 per cent copper. The third was genuine babbitt metal analyzing 89.5 per cent tin, 7.5 per cent antimony, and 3.0 per cent copper. We were desirous of ascertaining, if possible, their relative characteristics and advantages.

Bearings were made with each grade of metal and mounted on a support. The load was applied by means of a jack, and a beam scale used to determine the load on the bearing. The speed of the journal was maintained constant at four different velocities of 19, 20, 30 and 40 feet per second. When the temperature of the bearing reached a point which was constant, readings were taken. These values were plotted against various values of $P \times V$ as shown in *Figs.* 1, 2 and 3.

Similarity in the three cases is quite marked. The high lead content metal shows to advantage at lower velocities, below 20 feet per second. With higher velocities the temperature increases more rapidly than in the case of the other metals.

In the case of the 50 per cent lead metal the results are very good up to velocities of 30 feet per second, beyond which there is a tendency for a more rapid rise in temperature as the velocity increases.

The third tin base metal shows no advantages at the lower ranges of speed tested, but does show its superior qualities at velocities in excess of 30 feet per second.

Determines Limiting Temperature

The question arises as to what limiting temperature rise we should set. This may vary with the particular circumstances surrounding a given application. Electrical manufacturers use 40 degrees Cent. as a rating basis for their product, and while this has to do with matters foreign to this problem, it seemed wise to plot points against both V and P for a constant temerature rise of 70 degrees Fahr. above the ambient temp.; see *Fig.* 4. On the performance curves for each bearing metal have been superimposed curves of $P \times V^2$ in amount which seem to fit most closely the test results; at least this is true in the range of the higher velocities. Is not this what we would expect anyway when the laws of fluid friction apply? Are we not able now to prescribe a more rational rule which will establish our limits on the basis of an allowable temperature rise, and on the basis of $P \times V^2 = C$, where C is a constant for a particu-

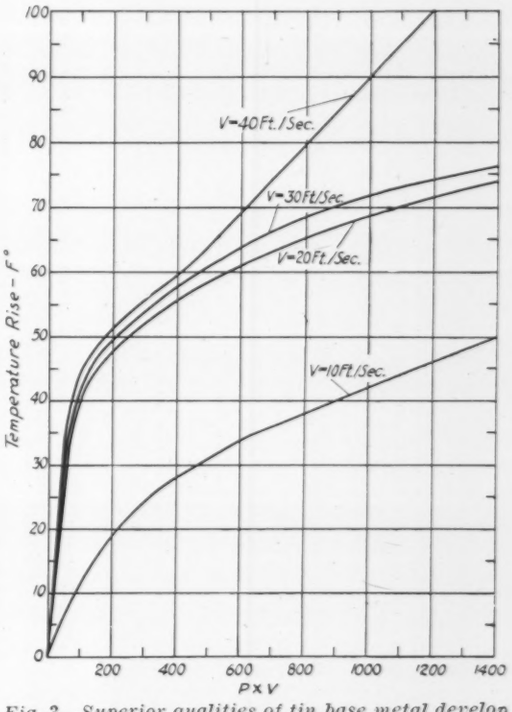


Fig. 3—Superior qualities of tin base metal develop at higher velocities

lar bearing metal, and not a widely varying quantity?

For a temperature rise of 70 degrees Fahr. we obtain for the lead base material a value of $C = 9000$, for the tin base babbitt metal 18,000, and for the intermediate 50 per cent lead mixture a still higher value of 24,000 at the higher velocities, and somewhat less at lower velocities, say averaging 22,000.

In the same way corresponding curves may be plotted for other values of allowable tempera-

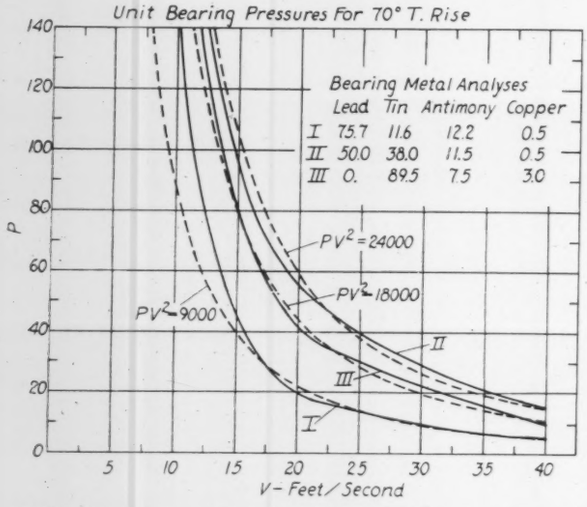

Unit Bearing Pressures For 70° T. Rise
Bearing Metal Analyses
Lead Tin Antimony Copper
I 75.7 11.6 12.2 0.5
II 50.0 38.0 11.5 0.5
III 0. 89.5 7.5 3.0
PV² = 24000
PV² = 18000
PV² = 9000
P
V - Feet / Second

Fig. 4—Comparison of temperature rise for bearings of varying analyses at increasing velocities

ture rise and the curve equation ascertained.

The particular bearing used in the test was of the self-aligning knee type, and with a bearing length of 3½ diameters. There were two snap rings located about one-quarter bearing length from each end. The bearing was broached and then scraped as needed, using an arbor oversize from 0.001 to 0.0015-inch per inch journal diameter, the greater allowance for smaller bearings below 3 inches diameter, and the smaller allowance for larger sizes. Shaft was ground to size.

The oil used had viscosity of 250 Saybolt at 100 degrees Fahr.

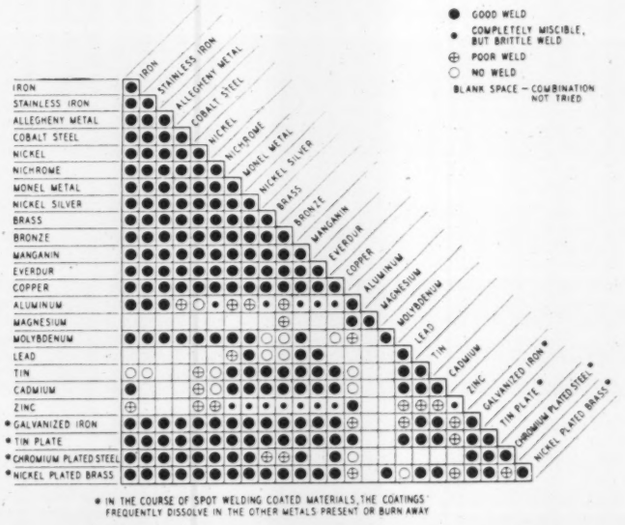
With regard to the temperature rise for which *Fig.* 4 is plotted, viz., 70 degres Fahr. other values may be preferred, if only from the psychological viewpoint. We have in these and kindred applications become so accustomed to bearings running cool that we may encounter added sales resistance if we standardize universally on limits which would persuade the average operator that the bearing was running hot.

The big value of the test lies in the determination of safe limits of loading for all likely ranges of velocity. In addition, it has paid for itself many times over through the elimination of the expensive tin base babbitt metal in all applications with the rare exception of instances where velocity exceeds 30 feet per second.

Gives Welding Properties of Metal Combinations

TO WELD two pieces of iron together is quite simple with ordinary precautions, but it has been found difficult to produce satisfactory welds between some of the diverse metals available to the designer. Each combination of metals may require different welding conditions, and to determine the optimum treatment has necessitated extensive study of spot welding by Bell Telephone Laboratories Inc. and reported in *Bell Laboratories Record.*

During the course of some of these studies the welding peculiarities of 250 different combinations of metals have been examined. Which of these can and which cannot be welded at the



Welding characteristics of some two hundred and fifty combinations of metals were recently tested for possibilities of spot welding

present time are shown in the accompanying illustration. A key to the symbols is in the upper right hand corner.

One disadvantage of any form of welding is the possible harmful effect of the intense local heating necessary. Although in spot welds this effect is greatly reduced, it cannot be entirely eliminated. Thus zinc is recrystallized and made brittle, iron may be slightly oxidized, zinc may be partly distilled out of brass, and duralumin and tool steels may be given an undesirable heat treatment. The area of local heating and undesired effects can be reduced considerably, without reducing the actual size of the spot weld, by using a high welding current for an extremely short time and by making welds under the surface of a cooling and protecting liquid such as water.

A User's Viewpoint—on Welding and Castings

ALMOST difficult point for the designer in the development of machinery is the intelligent selection of cast or welded structure. He has, in most cases, experience and records as to cost, mechanical properties and function of the cast structure, but in practically all cases he lacks this experience in relation to the welded structure. Such is the belief of Sol Einstein, chief engineer of Cincinnati Milling Machine Co., who presented the paper from which this article is abstracted at the recent American Society of Mechanical Engineers' meeting.

In a modern shop organization there exists, or should exist, intimate co-operation between the designing department, pattern shop and foundry so that when the drawings are finally sent to the pattern shop little or no difficulty is experienced in making patterns in conformity with existing foundry practice. Experience has taught designers, pattern maker and foundry superintendent how the part can be produced most satisfactorily. Now these same designers are faced with the entirely different problem of designing their parts to be produced by welding and it is quite natural that they experience numerous difficulties.

Welding Eliminates Delays

If a part is designed to be made of welded structure and the proper material is in stock, the building of the structure can be started at once. After having laid out the shape on a sheet, the operator cuts the shapes, generally with an oxyacetylene torch. He then assembles the various shapes so cut and begins welding them together. In some cases annealing and straightening may be necessary before the piece is ready for cleaning and the machine shop. The welded structure often can be produced in less time than it takes to make a pattern; particularly with modern equipment.

The elimination of the necessity for a pattern, and therefore the quicker delivery of the part to the shop, is the foremost advantage of the welded over the cast structure. However, if a part has to be made repeatedly or in quantities, the cost of the pattern can be amortized over a number of parts.

A modern foundry is as organized as any other machine department of a manufacturing establishment. We find there machines for making the molds and cores; sand and sand handling facilities; the patterns mostly mounted on iron plates with the proper size flasks for the molds; crane facilities for handling these patterns, molds and flasks; a cupola with its charging floor, proper provision for obtaining the desired mixture of the iron and the pouring ladles; and finally casting cleaning facilities. As long as a standard product is required, it can be handled in such a foundry in a satisfactory way. As soon, however, as larger parts are wanted, the problem of making castings may become more difficult due to the lack of proper facilities.

Requires Simpler Equipment

The welding department requires simpler equipment. We have cutting machines, generally in the form of either hand or motor driven oxyacetylene torches, for producing the proper shapes. For assembling these shapes, a large surface plate is used in combination with angle plates, clamps or other holding facilities. The welding machines are then used for completing the structure. An annealing furnace and a sand blast room are desirable and sometimes necessary. Finally, chisels and grinders for cleaning purposes are necessary. This equipment is less costly than the equipment of a modern foundry and it is more flexible, inasmuch as large or small pieces of work can be produced.

A few practical examples which illustrate the aforesaid points might be of interest. *Fig.* 1 shows a semispecial hydromatic milling machine in which the bed and table unit *A* is standard, while columns and spindle carriers *B* and *C*

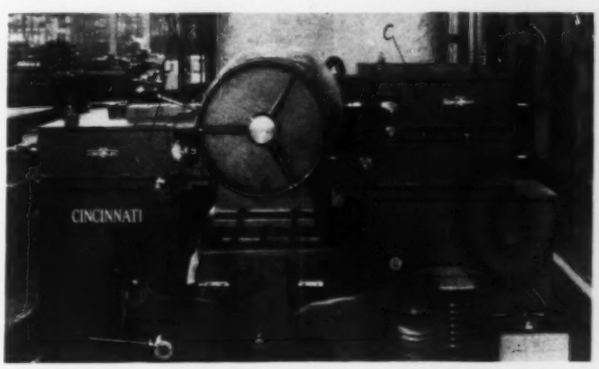


Fig. 1—As standard spindles were unsuitable, welded construction was employed

are made of welded structure. Due to the general arrangement of the multiple number of spindles in each spindle carrier, the standard spindle carriers and columns could not be used. To save excessive pattern costs and obtain quick delivery these columns and spindle carriers were made of welded structure.

Fig. 2 shows a small planer type milling machine in which the uprights *B* and rail with its spindle carriers are standard equipment, while the bed *A* is made of welded structure. This bed *A* had to be of larger width than our standard construction and of greater length. The cost of the pattern would have been excessive for producing one piece. Particular attention might be called to the similarity in appearance, indicating that welded structure can be made as neat in appearance as cast iron structure if the necessary care is taken.

Major Parts Are Welded

A ten-ton double-ram hydro-broach is shown in *Fig.* 10. While this is a standard machine, the major parts are made of welded structure due to the following consideration. The bed *A* is only about 10 inches high, approximately 4½ feet wide and about 9½ feet long and carries in it two compartments, one for the oil to be used in the hydraulic system for moving the rams and indexing the table, and the second for the tool coolant. The hazard of getting these reservoirs oiltight and the large size of the base with relatively small height made it desirable to fabricate this structure of welded steel. The upright *B* was made of welded structure particularly for the reason that the flask equipment of our foundry was not big enough to accommodate this size casting.

In spite of the fact that cast iron guideways had to be attached to this welded structure for properly and efficiently guiding the tool rams, it was deemed advisable to use welded structure instead of going to the expense of making

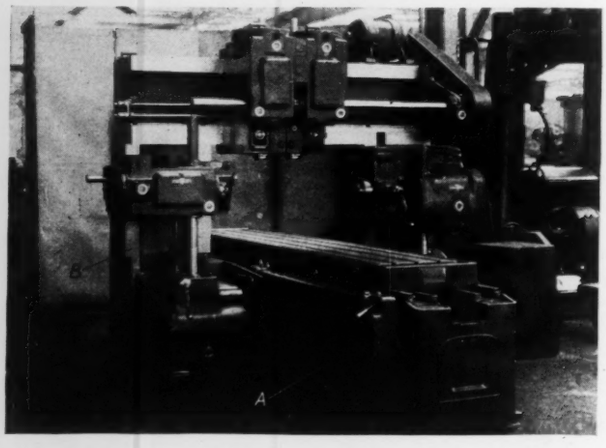


Fig. 2—Standard castings are used for uprights and rail while special bed is welded

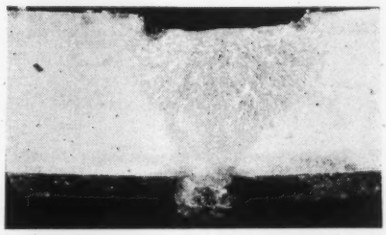


Fig. 3 — Poorly made weld which is undercut on the side from which metal was deposited

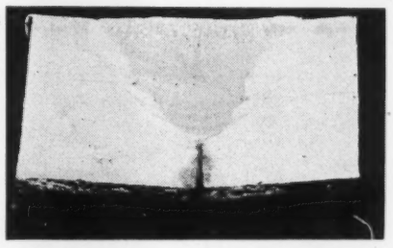


Fig. 4—Weld which has not penetrated completely to the far side

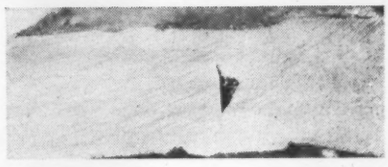


Fig. 5—Weld made from both sides with incomplete fusion at the root of the weld

it of cast iron. The third member, the knee *C*, is made of welded structure, being a box with approximately 1 inch metal thickness with certain supporting members for the work supporting table. The shape of this knee was such that considerable coring would have had to be done, which caused a decision in favor of the welded structure. Particular attention is called to the appearance of this machine.

Fig. 9 shows a large roll grinder for grinding rolls up to 60 inches in diameter and approximately 20 inches in length. The demand for machines of this type is naturally limited, and the frame parts are of very large dimensions, requiring big foundry equipment if cast iron structures are employed. Rear bed *A*, front bed *B*, work head *C*, grinding wheel slide *D*, tailstock base *E*, and journal rest *F* were made of welded structures. This machine weighed approximately 140,000 pounds and about 60 per cent of this weight was fabricated by welding. Since this is a precision machine, most of the welded structure had to be annealed. The grinding wheel head is of cast iron because it was necessary to make this part 100 per cent free of any vibration; and the tailstock head was made of cast iron because of the bearing for the large diameter spindle which slides in and out and has to be clamped in position. With welded steel structure a heavy bushing for this spindle bearing would have had to be supplied, being approximately 8 inches in diameter and 4 feet in length. The clamping of this spindle and taking up any lost motion would have offered considerable difficulties. This machine had to be delivered in three months and the welded structure materially favored this delivery date.

It is safe to say that in all cases where one piece has to be made and where such a piece is properly designed, the welded structure will result not only in quicker delivery, but also at lower cost. Thus we find that on semispecial and special machines or parts that the welded structure not only allows quicker delivery but gives in general a cheaper and sometimes better product. Also, very large parts of special or semispecial nature can advantageously be made of welded structure.

The whole situation changes, however, if parts or machines are produced repeatedly or in quantities. As stated in the foregoing, the cost of patterns can be distributed over a number of parts, and with a pattern in existence the foundry can deliver the casting in the same or better time than the welding department can supply the welded structure. Manufacturers of welded steel structures tell us that the price of their product properly annealed and cleaned is approximately ten cents per pound. If we take a price of a similar piece of cast iron at five cents a pound, it would be necessary that the steel structure be only one-half of the weight of the cast iron structure to have similar costs. If, however, some additional members have to be attached to the steel structure, such as slides and guideways, it can be readily seen that the cost factor is all in favor of the cast structure. This latter point of attaching additional elements to the welded steel structures makes their use much less attractive, particularly to the machine tool industry.

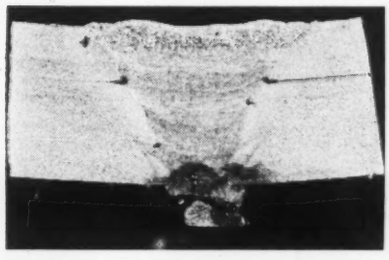


Fig. 6—Weld made from one side only on steel containing layer of gas-forming impurities

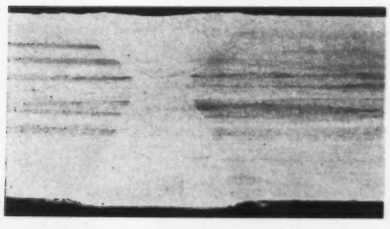


Fig. 7—Sound weld made on parent steel of poor welding qualities

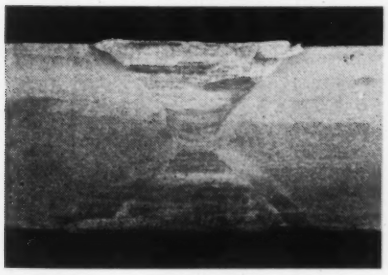


Fig. 8—Welded joint in which proper steel specifications and welding technique have been observed

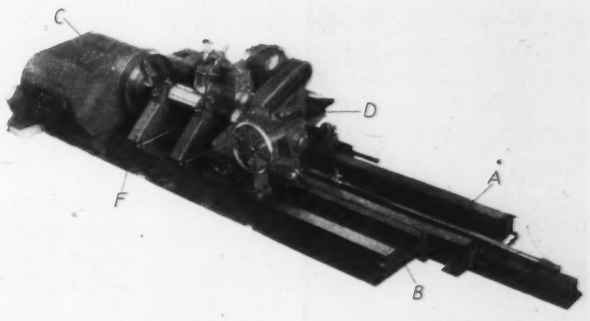


Fig. 9—Large dimensions of frame would require extremely large foundry equipment

It is difficult to say where the parting line of welded structures and castings in respect to cost lies. It is safe to assume, however, that where five or more pieces of a small or medium size part can be made off a pattern, the cast structure is economically preferable over the steel structure. However, it is our opinion that on machines where strains and stresses are an important factor, such as for example shears, brakes and punch presses, the welded structure will in time be the universal structure used, even if the machines are manufactured in quantities.

Similarly, it is our opinion that in cases where large quantities are used on parts of somewhat simple design, such as tanks, guards, etc., the welded structure might be the structure of the future. If automatic cutting machines are employed for shaping the sheets—if elaborate fixtures are used for assembling these shapes—and if automatic machines are used for producing the weld—we can see a field for welded structures on high production work.

Discusses Quality of Welds

A further discussion of welded parts was presented at the Mechanical Engineers' meeting by Everett Chapman of Lukenweld Inc. Mr. Chapman's paper included the following statements.

Modern weld metal is a freak. Its properties seem to give a clue to what might be expected from theoretically clean materials. It is possible to produce in the electric arc, in the form of weld metal, a steel with carbon content of 0.08 per cent, tensile strength of 65,000 pounds per square inch, and an elongation of 35 per cent in 2 inches. These properties, furthermore, are shown in the cast condition and material of the same analysis made in the open hearth by modern steelmaking practices will not begin to show, in any respect, the physical properties of the weld metal.

The essential difference seems to be, first, the treatment of minute drops of metal; second, the use of well-designed slag; third, exclusion of

the atmosphere; and fourth, temperatures much higher than can be obtained in the open hearth. The resulting metal is much cleaner than commercial open-hearth steel and it is not a coincidence that its physical properties are superior to open-hearth steel which is of equivalent chemistry.

The commercial existence of such a metal, together with the fact that it can be used to integrate rolled steel, have several important implications for the designer of structures and the makers of steel. The freedom of welded design inherently implies the ideal structure, with its smooth-flowing contours and its homogeneous, elastic properties. That such material as modern weld metal can be produced is an incentive to both the maker of steel and the designer of structures to reduce, perhaps eliminate, the number of damaging discontinuities in their steels and their structures. Without investigating the feelings, mathematical treatments and experimental methods that distinguish the master designer, it may be pertinent to illustrate some of the abuses of welded joints that tremendously detract from the efficiency of a welded structure.

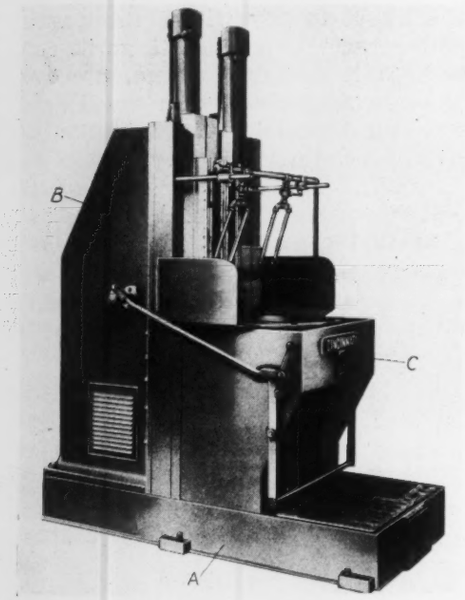


Fig. 10—*Cast iron guideways are attached to the welded structure in this hydrobroach*

Fig. 3 illustrates an example of welding that, if used under load, will entirely discredit the use of weld metal wherever such practice is found. The weld is undercut on the side from which the metal was deposited. The drippings of hot metal on the far side are not only badly oxidized, because they lacked the protection of the electrode, but also form a discontinuous projection which will introduce a high root stress. The designer's factor of safety covering this joint will have to be great enough to reduce to a safe value either the stress at the root of the undercut or the stress at the root of the oxidized projection, taking into account the damaged metallurgical condition of the drips.

Fig. 4 is an example of a weld that has not completely penetrated to the far side. The incipient rip, introduced by the unfused root, reduces the working strength of such a joint by at least six times.

Fig. 5 shows a welded joint made from both sides in which the workmanship was such that neither the weld metal nor the steel has an opportunity to perform as a homogeneous, elastic entity. The fusion at the root of the weld is incomplete, introducing a void at right angles to the applied load that is as bad or worse than any maximum stress condition that could be introduced by graphitic flakes.

Combination of Troubles Encountered

Fig. 6 illustrates a welded joint in which a combination of troubles are present. The weld has been attempted entirely from one side which results in the usual oxidized projection of metal on the far side. In addition, the steel itself was not properly adapted for ideal welding. It exhibits a layer of gas-forming impurities which, under the heat of the arc, produce great volumes of gas, generally in such large quantities that the electrode, with its normal boiling action, could not eliminate them. This joint again illustrates the abuse of material with excellent physical properties in conjunction with a parent metal that is not the equal of the material used for joining.

It is possible to make a good weld on poor parent metal if the proper technique is observed. *Fig.* 7 shows a sound, homogeneous weld made on a parent steel of poor welding properties. The parent metal exhibits several banded zones or laminations containing nonmetallic impurities which, under the heat of the arc, will give rise to volumes of gas, some of which certainly will be entrapped.

Fig. 8 demonstrates what can be expected today in a welded joint when the proper steel specifications and welding technique are observed. The joint as a whole presents little change in either external or internal contour. The stress condition over such a joint would be extremely uniform; there are no points of maximum stress of any magnitude. The metallurgical discontinuities that exist in such a joint, due to the thermal abuse of the arc, form different subject matter but they can, however, be corrected to produce a condition of complete homogeneity in the weld.

With the welding technique and the parent metal specification definitely known for the production of the type of joint illustrated in *Fig.* 8 it remains for the designer to evolve the ideal structure to meet the mechanical demands imposed by his problem.

New Machines Indicate Design Trends

NO DESIGNER would like his machine to be classified as a "rubber stamp" model—the assembly of a number of parts into a composite whole with the maker's nameplate attached—and no really worthwhile machine can be developed in this manner. Yet despite this, today's designs to a greater degree are combining standard parts with new ideas to create outstanding machines.

The specification of complete parts as a unit is too valuable a design short-cut to be neglected. More and more designers are turning to completely assembled motorized speed reducers, unit oil seals, pumps and motors as a unit, and similar parts which save detail specification. With the use of these parts greater time can be devoted to the ultimate purposes of design—the development of a complete machine that will do the job quicker, better or more efficiently.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Air Conditioning

Industrial Equipment,
Buffalo Forge Co.,
Buffalo, N. Y.

Unit Conditioner,
Harris Auto-Car Air Conditioner Corp.,
New York.

Brewery

Automatic Keg Scrubber,
Schlangen Mfg. Co.,
Chicago.

Construction

Convertible Shovel,
Osgood Co.,
Marion, O.

Road Shaper,
Fate-Root-Heath Co.,
Plymouth, O.

Tractor,
Bates Mfg. Co.,
Joliet, Ill.

Domestic

Battery Operated Safety Razor,
Morrill & Morrill,
New York.

Electric Refrigerator,
Gibson Electric Refrigerator Co.,
Greenville, Mich.

Food Mixer,
Lane Mfg. Co.,
Chicago.

Ice Cream Freezer,
Peerless Mfg. Co.,
Louisville, Ky.

Foundry

Counterbalanced Tumbling Mills,
Whiting Corp.,
Harvey, Ill.

Centrifugal Blast Cleaning Machines,
Pangborn Corp.,
Hagerstown, Md.

Jar Squeeze Molding Machines,
Tabor Mfg. Co.,
Philadelphia.

Industrial

Venturi Dust Collector,
Prat-Daniel Corp.,
New York.

Tiering Fork Truck,
Elwell-Parker Electric Co.,
Cleveland.

Portable Belt Conveyor,
Robins Conveying Belt Co.,
New York.

Yard Crane,
Industrial Brownhoist Corp.,
Bay City, Mich.

Water System,
Decatur Pump Co.,
Decatur, Ill.

Air Compressor,
Pennsylvania Pump & Compressor Co.,
Easton, Pa.

Metalworking

Air Turbine Grinder,
Onsrud Machine Works Inc.,
Chicago.

Die-Making Machine,
Foley Mfg. Co. Inc.,
Minneapolis.

Heavy Duty Plate Planer,
Baldwin-Southwark Corp.,
Philadelphia.

High Frequency Electric Drill,
Buckeye Portable Tool Co.,
Dayton, O.

Broaching Lathe,
Wickes Bros.,
Saginaw, Mich.

Hydraulic Riveting Press,
Hannifin Mfg. Co.,
Chicago.

Impact Wrench,
Ingersoll-Rand Co.,
Phillipsburg, N. J.

Municipal

Electric Siren,
Federal Electric Co.,
Chicago.

Pharmaceutical

Rotary Tablet Machine,
F. J. Stokes Machine Co.,
Philadelphia.

Power Boating

Outboard Motors,
Outboard Motors Corp.,
Milwaukee.

Printing

Test Presses,
Hacker Mfg. Co.,
Chicago.

Quarry

Roll Crusher,
Austin-Western Road Machinery Co.,
Aurora, Ill.

Full Floating Screen,
Nordberg Mfg. Co.,
Milwaukee.

Rubber

Crude Rubber Cutter,
Black Rock Mfg. Co.,
Bridgeport, Pa.

Textile

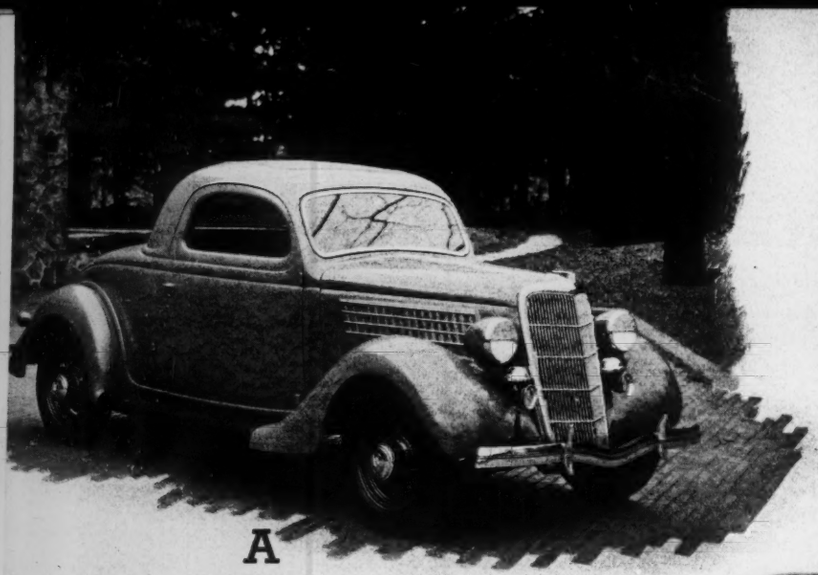
Automatic Knife Shear,
Hermas Machine Co.,
Hawthorne, N. J.

Facing Strip Sewing Machine,
Union Special Machine Co.,
Chicago.

Combination Winding and Cutting Machine,
Consolidated Sewing Machine & Supply Co.,
New York.

Transportation

Oil Burning Engine,
Continental Motors Corp.,
Muskegon, Mich.



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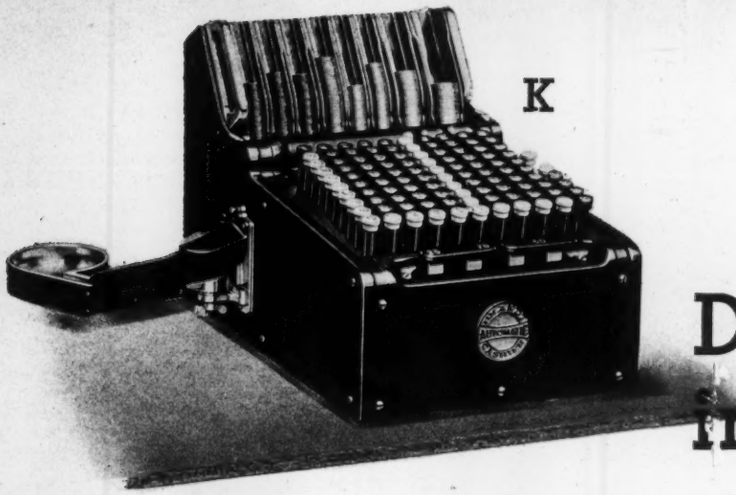

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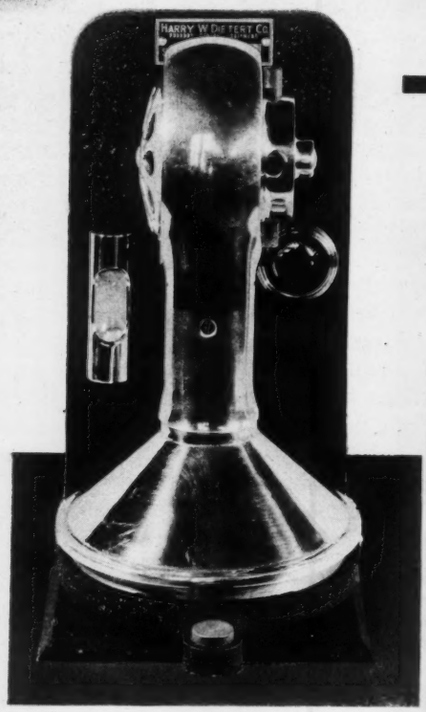

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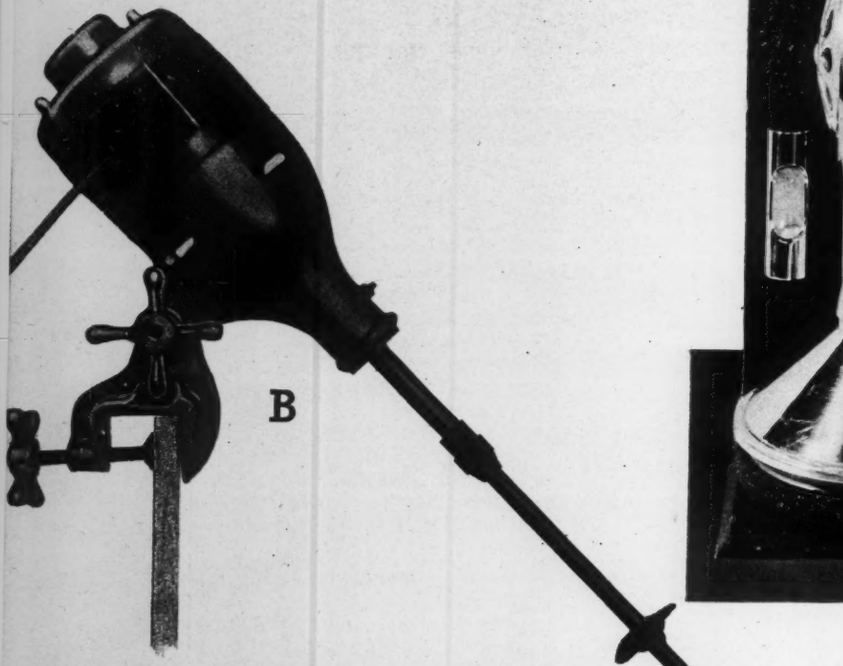

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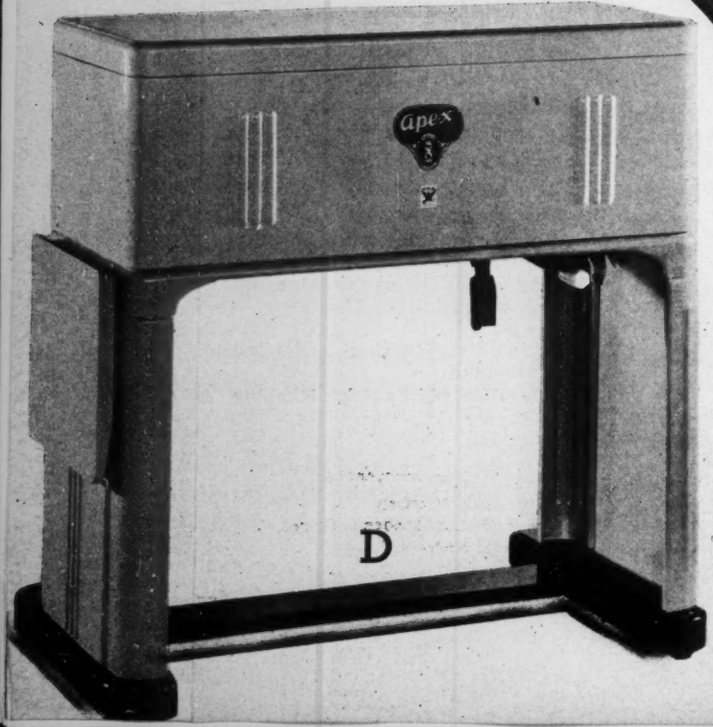


D

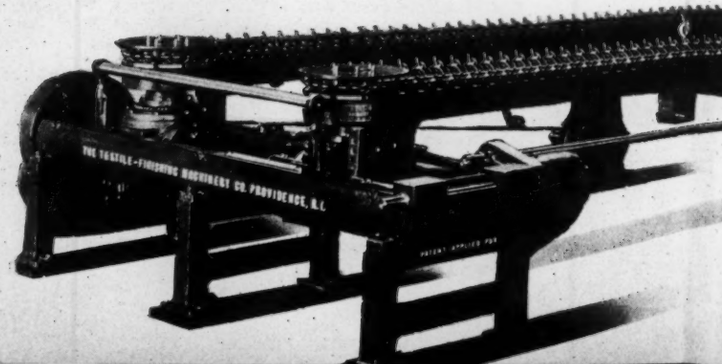
(A) Automotive developments draw major inte this month in the design field, with refineme rather than innovations being the trend. The Ford utilizes centrifugal force to supplement nor spring pressure in the clutch. Needle bearings welding are employed in the construction, while br shoes now are of the self-centering type.

(B) Widely spread ball bearings take up the whi the shaft on the portable power mixer of Patter Foundry & Machine Co. and give smooth operat The telescope shaft permits a long adjustment as main section also runs all the way through the mo Aluminum is used in the case of the machine to ins lightness.

(C) Air is forced over an electric heating element a motor driven blower in the Harry W. Die Co. sand moisture teller. The sand pan is held aga the bottom flanged portion of the air tube by me of a spring-loaded holder. The base of the machine cast aluminum.

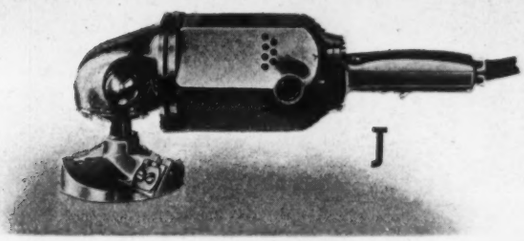
(D) All moving parts are totally concealed in new ironer which reflects the trend in comm cial design. Action of controls in the unit, built Apex Rotarex Corp., has been speeded up to give stantaneous response. A safety shoe release is wit easy reach of the operator's hand.

(E) In order to insure longer life for driving sprock and chain, remove any unnecessary strain on main drive and shaft and eliminate vibration, driving mechanism of the Textile-Finishing Machin Co. tenter is so designed as to be practically a separ self-contained unit.



Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.



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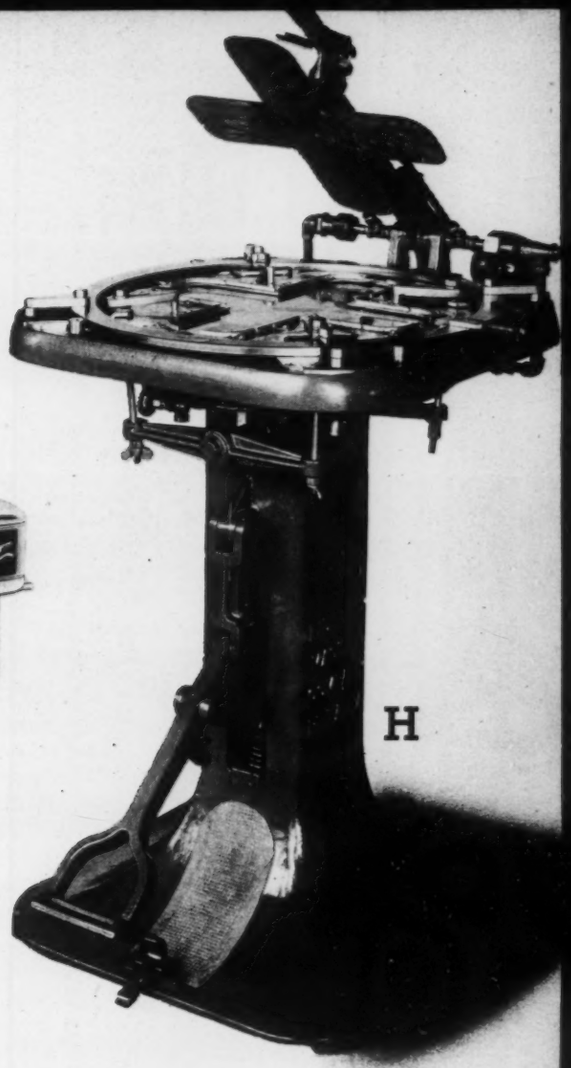

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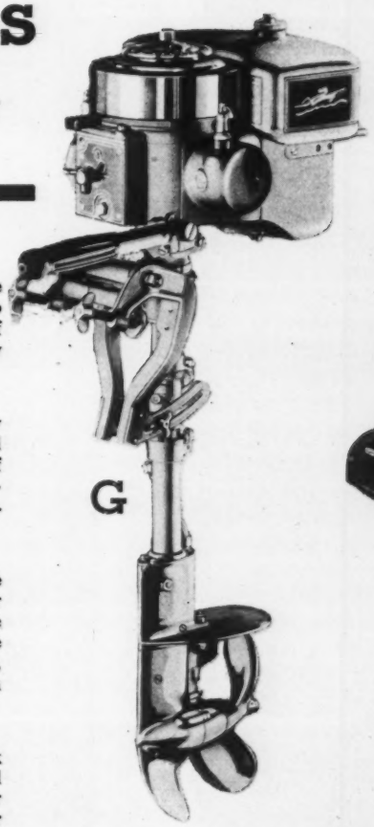


G

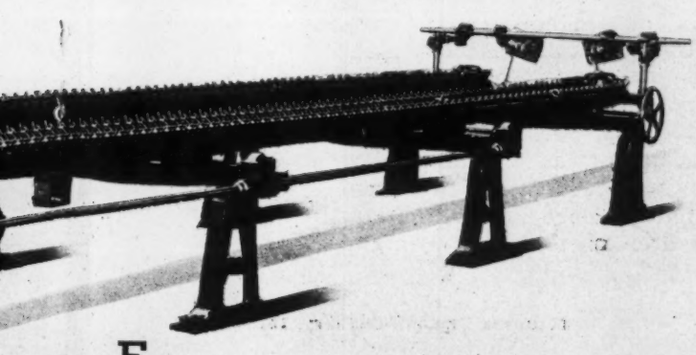
(F) The length of both the lever for operating the footstock and its handle have been increased to facilitate operation in the new cylindrical grinder of Norton Co. Power traverse machines are hydraulically propelled.

(G) Aluminum cylinders with pressed-in nickel alloy iron sleeves are employed in the new outboard motors of Johnson Motor Co. The propeller shaft is of stainless steel, selected for strength and to resist corrosion. A cast aluminum watercooled muffler is employed.

(H) A recessed ring on top of the Fidelity Machine Co. multiple die creasing ring allows for larger sized dies than those used heretofore. Fittings for the arm pivot are solid, instead of the former three-piece unit, thus eliminating steam leaks. A frame of tubing, once employed, has been replaced by a neater cast iron base.

(J) The new portable electric rotary planer of Black & Decker Mfg. Co. is built around a universal motor which operates equally well on alternating or direct current. The planer, for application wherever wood surfaces are to be smoothed or shaped, is designed for appearance, and for balance of weight.

(K) An automatic coin lock prevents the depression of keys that involve coin channels in which the supply of coins has fallen to a low point in the new machine of Brandt Automatic Cashier Co. Coins roll on edge into the cup upon depression of a key. Roller bearings are provided for important moving parts. Interior steel parts are especially treated to prevent rusting.



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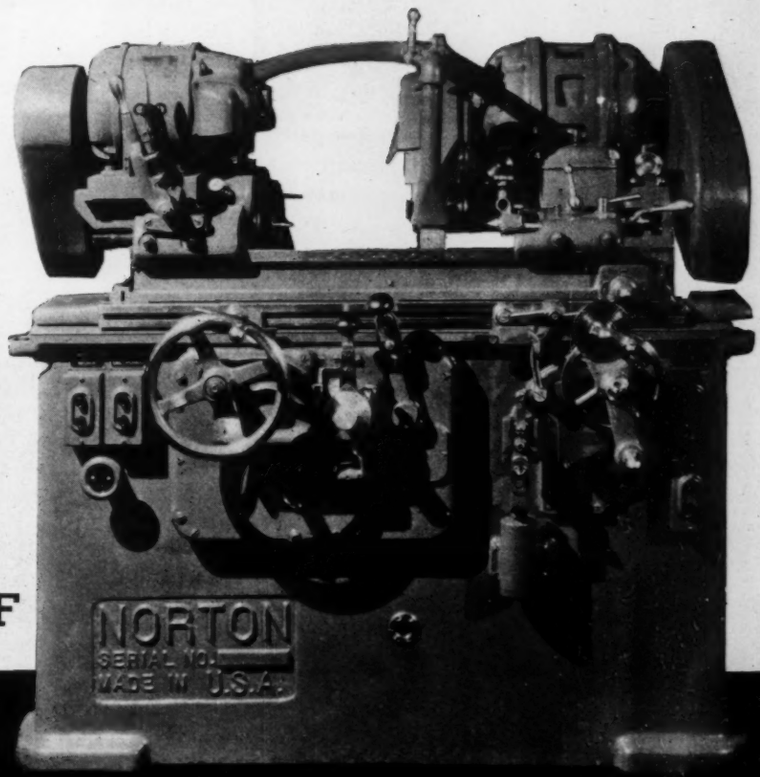

F

MACHINE DESIGN

More and Better Machinery Essential to Meet Foreign Competition

AS YE sow, so shall ye reap!" Eighty years ago Commodore Perry sailed to Japan and practically delivered an ultimatum that trade negotiations be opened between that country and the United States. Today it seems the plan has succeeded too well —insofar as Japanese imports are concerned!

The Japs have advanced since that time at a greater rate of acceleration than probably any other country during a similar period. If this acceleration continues and steps are not taken to meet it, we can ultimately expect such competition in trade as seldom, if ever, before experienced.

It has been said the Japanese are copyists. This is correct in regard to many of our mechanical products. Locomotives, instruments, valves—even ships—have been copied so faithfully that difficulty is experienced in distinguishing between even the trademarks of the original and the facsimile! But that design method will not continue. Japan is progressive and aggressive as epitomized by the sale in this country of such items as lamp bulbs and by the report that arrangements have been made for the importation of quantities of Japanese automobiles into Germany and Holland during 1935—to sell at a fraction of the price of the nearest competitive models.

The Japanese copying era may soon be over and may well be replaced by initiative and originality. Would it not be wise for engineers, government authorities and the nation as a whole to recognize this fact and do some more "sowing" before a situation arises that could very readily prove intolerable?

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Auto Design Again Points the Way

AS THIS is written the National Automobile show is in full swing. This year's exhibition discloses less in radical new design than shows of recent years; beauty of line and refinements in general seem temporarily to have taken the place of sensational departures. Such departures are on the way again, however, as evidenced by the interest in certain quarters in the rear-engined car, and by the adoption of electric gear shifting by at least one manufacturer.

A trend toward the use of new types of bearings and bearing metals is brought out by the current show. Cadmium-silver-copper alloy is being used for crankshaft and connecting rod bearings, and the needle type bearing is in much greater evidence. It will be recalled that the automotive industry influenced, perhaps more than any other factor, the present widespread use of the ball and roller bearing. Can it not be that the same thing will occur again in regard to the needle type bearing, the transition to more automatic control, increased use of metal in bodies, greater appeal to the eye, and other refinements?

PROFESSIONAL VIEWPOINTS

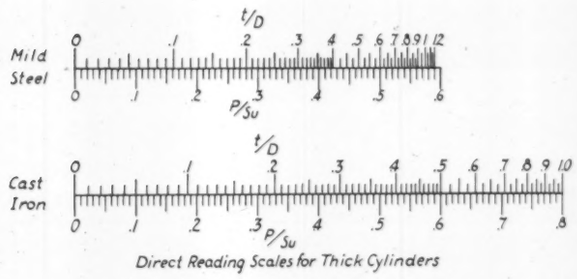
Machine Design Welcomes Letters Suitable for Publication

Strength of Hydraulic Tubes

To the Editor:

THE current interest in hydraulic drives calls for better data, based on carefully made tests, for hydraulic tubes and cylinders. Formulas and designs much used in the past have been principally based on the Lame thick-walled cylinder theory, and these formulas have not been entirely satisfactory as regards comparison with test results and design calculations.

The various theories of elastic strength lead to surprising differences in conclusions. Principal theories of strength are based on assumptions of stresses and strains. An extended search in bibliography and comparison with known data of the writer's experience, shows the experiments made by Cook and Robertson (Strength of Thick Hollow Cylinders under Internal Pressure," *Engineering,* Dec. 15th, 1911) to be the most trustworthy. These experiments covered widely different ratios of thickness to internal diameter. Tests were made with both cast iron and steel. The steel test pieces were made with a tough, mild steel quality, which would closely apply to well annealed steel castings or forgings.



Dimensions of hydraulic tubes and cylinders can be quickly determined by nomographs

As cast iron will undoubtedly continue to be used for the lower pressures, say 2000 pounds per square inch and under, the results of Cook and Robertson's tests are of special interest. With the improvement in strength and ductility due to alloying with various other metals, cast iron will be safer for these purposes than with the metallurgy of the past. In high hydraulic pressures, one of the principal difficulties has been to get a close grained structure in cast iron. Therefore, with ordinary cast irons, pressures above 2000 pounds per square inch should be carried in either steel castings or steel forgings, until some other and more reliable means of closing the grain in cast iron is found.

It is rather surprising that cast iron follows the maximum stress theory as regards its bursting strength, but not so surprising when one considers that cast iron is a brittle material. Cook and Robertson's tests show quite close agreement with the Lame maximum stress theory for cast iron, in terms of its ultimate strength.

Mild steel tubes and cylinders, as regards bursting pressures, do not follow either the maximum stress difference theory nor the maximum strain theory (without longitudinal stress); but a series of test points plotted against both of these theories shows a curve lying approximately halfway between these two theories. The equation obtained by an analysis of Cook and Robertson's tests for mild steel tubes and cylinders, is of the type

$$t/D = ax^m + bx^n + cx^p$$

where x is the proportion of pressure/ultimate strength; all of the exponents being inconvenient decimals. t is the thickness of wall and D the internal diameter.

Since all thick-walled cylinder formulas are inconvenient and cumbersome, the writer has prepared direct-reading nomographs or scales for both cast iron and steel tubes and cylinders so that t/D can be read off directly opposite the ratio, internal pressure divided by ultimate strength. In this way dimensions of tubes and cylinders can be quickly determined; best of all, perhaps, knowing the results will be in accordance with carefully worked out tests, instead of relying on some theory of strength that is probably open to doubt.

—JOHN S. CARPENTER,
Consulting Engineer

Tabulated Drawings Conserve Time

To the Editor:

IN MOST debatable topics people are inclined to express extreme views without giving full consideration to all sides of the question. The case of tabulated drawings is no exception. The article in the August issue of MACHINE DESIGN reminded me of much criticism which I have

heard directed at tabulated drawings. On the other hand, tabulation has a distinct field of usefulness if not carried to excess.

In the fields of industry where hundreds or thousands of parts are produced from the drawing, tabulation should be avoided. The drawing cost per piece becomes a small proportion of total cost. In direct contrast to this is the heavy industry which develops its line by gradual improvements rather than by new models. Such firms must keep simple, low-cost records so as to be able to supply repair parts for the older designs after the drawings have been changed to incorporate improvements. For such purposes *simple* tabulation of a *small* number of dimensions is a valuable conservation of time and expense.

A drafting room shortcut is no economy if it causes difficulty and risk of error in the shops. One important feature is that the tabulation must be located in a recognized portion of the sheet. The reference letters on the body of the drawing must be bold so as to be readily located, a point so obvious and yet ignored so persistently.

Despite the comments of Mr. J. C. Rah in the October issue, the writer has proved that it is possible to satisfy a critical shop personnel, working under a piece-work system, by tabulation of drawings for machine parts. Drawings of simple standard parts such as studs, nuts, etc., can be made clear and practically foolproof by careful arrangement and spacing. For instance, vertical columns should be arranged with the narrow and wide spaces interspersed so that it is easy to recognize the required column. Emphasis of certain columns by the use of light, medium and heavy weight vertical lines also helps towards this end.

A tabulation should not carry more than four or five rows of figures in each group. Between these groups a repetition of the headings serves as a fresh starting point for another section of four or five rows of figures. Very often standard sheets cover a range of sizes which can conveniently be sub-divided into groups of rows by listing nominal sizes in the first vertical column at the left of the sheet. A further safeguard is added by duplicating this column at the right side of the sheet, thus giving a two-way pick-up for any required horizontal row of figures.

—W. S. Brown,
Auburn, N. Y.

Reprints of Patent Articles?

To the Editor:

YOU HAVE been running a series of articles by George V. Woodling relating to patents. Are there any reprints of these available, and if so, how much would they cost per set?

—Louis A. Maxon, Patent Department,
Sullivan Machinery Co.

Editor's Note—Reprints of Mr. Woodling's patent articles are not available at the present time, although there is a possibility that these articles will be reprinted after the conclusion of the series.

Investigating Cylindrical Bodies

To the Editor:

IN THE article on this subject on page 37 of the April, 1934 issue of Machine Design the formulas given hold only for gun steel, but the article as published gives the impression that the formulas are for all thick-walled cylinders. Also the second formula given is misprinted.

The correct general formula is in the form of three equations, one for the tangential stress at radius r, one for the compressive stress (at radius r) which is normal to the circumference, and one for the longitudinal stress, which is uniform throughout the cross-section.

For open cylinders the longitudinal stress is zero. The compressive stress is always smaller than the others, so is seldom computed.

The general formula for the tangential stress is a combination of Lame's and Clavarino's formulas. It is written:

$$S_T = \frac{(1-2\lambda)(w_1 r_1^2 - w_2 r_2^2) + (1+\lambda) r_1^2 r_2^2 (w_1 - w_2)/r^2}{r_2^2 - r_1^2}$$

for closed cylinders, and

$$S_T = \frac{(1-\lambda)(w_1 r_1^2 - w_2 r_2^2) + (1+\lambda) r_1^2 r_2^2 (w_1 - w_2)/r^2}{r_2^2 - r_1^2}$$

for open cylinders.

One author gives the following values for λ.

Glass 0.25
Steel 0.30
Lead 0.43
Gun Steel 1/3 [in U. S. and Europe (except France)].
Gun Steel 1/4 (in France)

Substituting 1/3 for λ, the foregoing formulas are as follows:

$$S_T = \frac{(1/3)(w_1 r_1^2 - w_2 r_2^2) + (4/3) r_1^2 r_2^2 (w_1 - w_2)/r^2}{r_2^2 - r_1^2}$$

for closed cylinders of gun steel, and

$$S_T = \frac{(2/3)(w_1 r_1^2 - w_2 r_2^2) + (4/3) r_1^2 r_2^2 (w_1 - w_2)/r^2}{r_2^2 - r_1^2}$$

for open cylinders of gun steel.

These are the formulas which appear in the Machine Design article except for the typographical error in the second formula. The error is in the last term of the numerator being given as $r_1 r_2 (w_1 - w_2)/r^2$ instead of $r_1^2 r_2^2 (w_1 - w_2)/r^2$.

—Fred L. Cook,
John Robertson & Co. Inc.

MEN OF MACHINES

TO SUCCEED the late Dr. Calvin W. Rice, the A. S. M. E. Council has appointed C. E. Davies as national secretary. He has been a member of the society's staff for fourteen years and became executive secretary in 1931. His rise in the organization bespeaks his ability.

A native of Utica, N. Y., Mr. Davies obtained his early education at Utica Free Academy. In 1910 he matriculated at Rensselaer Polytechnic institute, graduating a mechanical engineer.

The first two years he was on the A. S. M. E. staff he served as associate editor, then managing editor and assistant secretary. He is a member of numerous other technical, scientific and social organizations and was the first secretary of the Engineers' Council for Professional Development.

C. E. DAVIES

• • •

E. E. JOHNSON

COMPANIES continue to reach into their research laboratories for men qualified to carry out work in other fields. A case in point is E. E. Johnson, who recently was moved from his post as assistant engineer of the General Electric research laboratory to that of engineer of the generator voltage regulator department.

Following his graduation from Washington State college in 1922 with the degree of bachelor of science in electrical engineering, Mr. Johnson entered the testing department of the company. There he remained two years.

Subsequently he was placed in the engineering general department where he became assistant to R. E. Doherty, now dean of the school of engineering at Yale. In 1931 he transferred to the research laboratory as assistant to L. A. Hawkins.

• • •

NATIONAL recognition in metallurgy has been won by Benjamin F. Shepherd, new president of the American Society for Metals. He is an authority on tool steel and carburizing, having originated the Shepherd hardenability test as well as a set of fracture grain size standards.

For twenty-three years Mr. Shepherd has been associated with the Ingersoll-Rand Co. and now manages its rock drill division. This position he has held since May, 1933. Born Sept. 6, 1893, in Phillipsburg, N. J., he graduated from high school in 1911 and entered the employ of the company the same year.

In 1918 he carried out research work at Columbia university as a special student of Dr. William Campbell. Eleven years later the Ingersoll-Rand company named him chief metallurgist. Lately

B. F. SHEPHERD

Mr. Shepherd has been active in developing the P-F characteristic of certain tool steels, a correlation of penetration of hardness with fracture grain size. Prior to assuming office of president of the A.S.M., he was active for a year as vice president and was a member of the board of directors in 1930-31.

* * *

KARL M. WISE, former Pierce-Arrow engineering director, has become associated with Bendix Aviation Corp. as technical advisor, and also vice president in charge of engineering of Marshall Asbestos Corp.

* * *

DR. IRVING LANGMUIR, associate director of General Electric's research laboratory at Schenectady, N. Y., has been awarded the Fourth Order of the Rising Sun by the government of Japan. The decoration is bestowed in recognition of his distinguished service.

* * *

J. M. LESSELLS, who was manager of engineering, Westinghouse Electric & Mfg. Co., now is a member of the firm, Lessells, Timoshenko & Karelitz, consulting engineers, Swarthmore, Pa.

* * *

A. E. RAYMOND recently was appointed chief engineer of Douglas Aircraft Co. Inc., Santa Monica, Calif., succeeding J. H. KINDELBERGER who resigned to become engineering head of General Aviation.

* * *

DR. WILLIS R. WHITNEY, vice president in charge of research, General Electric Co., has been awarded the 1934 Edison medal by the American Institute of Electrical Engineers.

* * *

H. C. JENNISON, formerly technical superintendent of American Brass Co., now is technical manager of that organization.

* * *

E. P. POLUSHKIN has joined the staff of Lucius Pitkin Inc. as associate metallurgist in research and development.

* * *

E. B. MEYER, vice president, United Engineers & Constructors Inc., Newark, N. J., has been nominated president of the American Institute of Electrical Engineers.

* * *

JOHN G. ZUMMACH, mechanical engineer, has joined the staff of the Hexcel Radiator Co., Racine, Wis., as chief engineer. He will have complete charge of the company's commercial and air conditioning operations.

* * *

THOMAS B. LITTLE has been appointed active managing director of the Association of Iron and Steel Electrical Engineers by recent appointment of the board of directors, succeeding John F. Kelly who died Nov. 16.

* * *

CHARLES S. LOCKWOOD, eighty-three years old, was honored recently at a testimonial dinner by the executive staff and department heads of Hyatt Roller Bearing Co. He has completed sixty years of continuous service in the employ of John W. Hyatt's several enterprises, forty-two years of which have been with the Hyatt bearing company. Despite his age he is an active member of the experimental staff of the organization.

* * *

ALPHONSE F. BROSKY has been appointed special engineer of Jeffrey Mfg. Co., Columbus, O.

* * *

CLYDE E. PLOEGER has been appointed chief engineer of the commercial refrigeration division of Servel Inc., Evansville, Ind. He has been a member of the engineering department since 1925, and for the past several years has served as research engineer.

* * *

CHARLES M. PACK recently rejoined the Doehler Die Casting Co. as assistant to the president in charge of research and development work.

* * *

C. J. SCRANTON, recently appointed chief engineer, harvester division, Allis-Chalmers Mfg. Co., is located at the company's plant at LaPorte, Ind. He formerly was designing engineer for the Avery Power Machinery Co.

* * *

WALTER ELLIOTT, chief engineer and supervisor of the sheet metal and stamping division of Stevens Walden Inc., Worcester, Mass., recently resigned to become engineer in charge of manufacturing for the Whitney Mfg. Co., Hartford, Conn.

* * *

A. W. SCARRATT, who for several years has been engineer in charge of International Harvester's motor truck engineering division, recently was made chief engineer in charge of the company's entire automotive engineering activities.

Obituaries

DR. KARL VON LINDE, 92, originator of the Linde process for manufacturing liquid air, oxygen and other gases, died recently at his home in Munich, Germany.

* * *

WILLIAM CAMERON, president, Cameron Can Machine Co., Chicago, died recently. He was 61 years old. An authority on the manufacture of high speed automatic can making machinery, Mr. Cameron held patents on many developments in the mechanical engineering field.

* * *

PLINY E. HOLT, recently vice president and chief engineer of Caterpillar Tractor Co., died Nov. 18, age 62. A chief engineer of Holt Mfg. Co., Stockton, Calif., he became connected with the Army Ordnance Corp. in the war and developed a one-man tank for which he became well known.

* * *

CHARLES O. BARTLETT, 84, who with the late K. F. SNOW founded the Cleveland organization which bears their names, died recently at his home in Brecksville, O. Both men made substantial contributions to the early mechanization of many industries in this country and Canada. Mr. Bartlett relinquished his active connection with the business of his company in 1922 when he resigned from its presidency.

Assets to a Bookcase

America's Hour of Decision

By Glenn Frank; published by Whittlesey House, New York; available through Machine Design *for $2.50 plus 15 cents postage.*

One book covering our economic status that is being widely and seriously read constitutes an indictment of our system. The title itself is a warning and when the reader is confronted with such chapters as Democracy Flouted, Freedom Invaded, Plenty Renounced, Science Betrayed, etc., he definitely concludes that Dr. Frank has something unusual to say. The tract, as he calls it, may be accepted as a competent guide in studying present conditions.

Of the host of books on economic subjects this is one particularly recommended for the engineer. It contains a case for the machine and the designer who has been working earnestly to build equipment that will be more rapid in production. For the better part of a generation, Dr. Frank says, we have been working in terms of an age of plenty but thinking in terms of an age of scarcity. To him it is incredible that in a world of tragically unfilled human need we should now set upon the Quixotic attempt to increase welfare by destroying wealth on declining to create it.

After the sweat and science of generations have brought us out of an economy of scarcity into an economy of plenty, are we to confess that we are incapable of managing plenty and deliberately legislate modified famine in just those areas of our enterprise where production has proved most efficient, he asks. This question is one which everyone can afford to consider seriously. There are many ways in which we as engineers can lend assistance in unraveling the economic tangle in which civilization has become enmeshed.

Dr. Frank's book is not written to throw its readers into despondency. Its purpose is to stimulate thinking. He says that a business and industrial leadership that will take as its job the conquest of poverty and qualitative famine, as he has defined them through the pages of his volume, will open up the biggest new market we have yet known, solve such problems of surplus as exist, realize even on a narrowed profit margin larger total profits than it has dared imagine, and make the industrial gains of yesterday seem dwarfs. The achievement of these ends requires, he says, that we deliberately construct an economics of plenty in consonance with the prolific productivity of this age of science, technology and power production.

□ □ □

Torsional Vibration

By W. A. Tuplin; published by John Wiley & Sons Inc., New York; available through Machine Design *for $5.50 plus 15 cents postage.*

Although no new phenomenon in engineering, torsional vibration has gained increased prominence as a result of modern trends in design. Designers necessarily must give more study to this factor in order to attain successful results. According to the author, the development of the internal combustion engine, which is the prime mover most likely to give rise to serious torsional vibration, has raised the subject to one of considerable practical importance. No projected design of power installation incorporating that type of engine can be regarded as a sound unit unless its torsional vibration characteristics have been investigated thoroughly.

The book endeavors to explain in simple manner those parts of the fundamentals of the vibration theory which are necessary for a complete understanding of practical problems. More particularly, however, it is intended to show in detail the procedure to be followed in actual calculations, this being often more troublesome than the elucidation of the basic principles.

Check calculations are given wherever possible, but the author points out that no attempt has been made to secure exact agreement by specially accurate working. The ordinary 10-inch slide rule has been used purposely, this being the designer's most portable tool. Calculations which involve repeated use of certain processes are given in tabular form.

□ □ □

A. S. T. M. Tentative Standards

Issued annually; published by American Society for Testing Materials; available through Machine Design *for $7.00 in paper binding and $8.00 in cloth, plus 15 cents postage.*

Contains 236 tentative standards of which 48 are new. Sixty were revised during 1934. Twenty-five standards are on ferrous metals, twenty-five on nonferrous and others cover diversified materials.

TOPICS

A REVIVAL of confidence in the capital goods industries was revealed through the business success which rewarded exhibitors of the eleventh National Exposition of Power and Mechanical Engineering held in New York the early part of December. Two hundred and forty-five companies were represented in the exhibits. Cutting power cost was the keynote of the show. Equipment on display gave evidence that the past several years of industrial inactivity provided time for research and development departments to catch up in their work and carry design well ahead.

* * *

Proposes Plan to Aid Industries

Here is something that certainly would stimulate design. Creation of a $1,000,000,000 railroad equipment corporation by the United States government as a means for stimulating activity and employment in the heavy industries recently was urged before the Economic Security conference by John F. Carmody of the National Mediation board. His idea is that if Uncle Sam through this corporation would finance the construction of modern streamlined trains, they could be rented to the railroads. Further, in renting this equipment from the government the railroads would avoid going further into debt.

* * *

Cites Uses of Materials in Airplanes

Summing up the progress in aeronautical engineering, Rear Admiral Ernest J. King, chief of the bureau of aeronautics, speaking before the A. S. M. E. aeronautics division, called attention to the increasing use of stainless steel in airplanes due to its ability to withstand corrosion. However, he asserted, aluminum alloys continue to make by far the larger volume of materials employed. Magnesium alloys, he added, undoubtedly have their applications, although this type of material is comparatively new.

Power plant development, according to the Admiral, continues to point toward higher supercharging. Two-row radial engines soon will be in service. Investigation and study of the diesel aircraft engine is an important project. Attention is being directed more and more to high altitude flying equipment, and it is safe to predict that important advances will be made in this field within the next two years, according to Rear Admiral King.

* * *

Industry Reveals Big Program

There is welcome news in the announcement of a half billion dollar program of plant improvements and replacement planned for 1935 by several large industrial concerns. This is one of the most important developments in the better housing program and furnishes evidence of the growing tendency of industry to co-operate with the Federal Housing administration in its campaign to stimulate the building and durable goods industries.

* * *

Trial and Error System Eliminated

From the Bohn Aluminum & Brass Corp. comes the announcement of a new method of determining the shape and dimensions of the combustion chamber of auto engines, location of the spark plug, and other factors to provide maximum efficiency. David E. Anderson is credited with the invention which is said to eliminate the trial and error system in designing these parts.

* * *

Air Conditioning Is Stimulated

Construction of air conditioning units for installation in homes financed under the Federal Housing Act is under way in plants of all major manufacturers of refrigerator and cooling equip-

ROLLING ALONG TOGETHER

M-R-C is not merely the name of a line of ball bearings. M-R-C represents the combined experiences, creative talents and engineering abilities of three of the oldest and most reputable makers of bearing equipment in the country—Gurney, SRB and Strom.

Consider this fact in connection with your own bearing requirements. Taken alone, any one of these famous names would certainly merit your consideration. Together, they represent an unquestioned source of all that could be desired in ball bearing performance, dependability and service.

May M-R-C serve you? We are available for engineering advice, suggestions or estimates on any regular or special needs, without obligation.

MARLIN-ROCKWELL CORPORATION

Jamestown, N. Y.

M-R-C Ball Bearings

ment. The new units, designed primarily to fit into homes valued at $12,000, will be featured in consumer sales campaigns opening late in February or early in March.—*New York Times.*

* * *

Survey Shows Designers' Responsibility

Importance of considering the operator in design of machinery is shown by facts brought out recently by Prof. Harry M. Johnson, psychologist in the graduate school of the American university. The tired person may show every characteristic of some form of insanity and not always in a mild degree, he asserted. Clumsiness, inattention, disturbance of speech, lapses of memory, headstrong persistence, momentary hallucinations, occasional delusions, wanton ruthlessness and temper tantrums all are common symptoms of fatigue, although they may not all occur at once, Prof. Johnson said. With this the case it is imperative that every designer make the utmost effort to prevent machines from causing fatigue among individuals who operate them.

* * *

Aircraft Production Gains Ground

It is interesting to note that the number of airplanes built in this country during the first nine months of 1934 represents a total increase of 220 units over the corresponding period in 1933. Aircraft manufactured during the nine-month period in 1934 aggregated 1285, of which 673 were for domestic civil use, according to the survey by the bureau of air commerce.

* * *

Sun's Energy Operates Minute Motor

Man's ability to harness the sun's energy is a step nearer realization. Recently produced in the General Electric research laboratory was a photoelectric cell, far more sensitive than usual ones of its type, by which sufficient electric energy can be obtained directly from sunlight to operate a minute electric motor. Four of the cells, connected together, operate the motor that is rated at four ten-millionths of a horsepower.

* * *

England Builds Composite Plane

Engineers are watching with interest the development of a composite plane now undergoing construction at Short Brothers' Works in England. Designed by Major R. H. Mayo, this unique craft is expected to accomplish what past experiments of Dr. Hugo Junkers indicated was possible, namely to launch a long range, heavily loaded plane from the back of a carrier plane at an altitude at which the upper craft can most easily take off. The composite craft consists essentially of two airplanes, a smaller, heavily loaded plane mounted on the top of larger plane with comparatively light wing loading per square foot. The two machines are so coupled that they can be separated either automatically or by pilot control.

* * *

Auto Makers Recapture Foreign Trade

Particularly encouraging is an analysis of the automobile export business. Reports show that much progress has been made in the last year toward recapturing foreign markets for American-made cars. Proportion of foreign sales of American cars to total sales outside the United States now is thirty-one per cent. Before the depression one of every two autos sold in foreign countries was an American car. However, the proportion declined to one of every five in 1932. Largest gains in auto sales by American exporters have been in South Africa, New Zealand, Australia, Japan, Brazil and Sweden.

* * *

Camera Weighs Fourteen Tons

Speaking of large cameras, there is one in the basement of the commerce department building in Washington that weighs fourteen tons. It recently was placed in service to make photographs measuring fifty by fifty inches of airplane maps and navigation charts. Two years were required to build the camera at a cost of $15,240. The unit is a delicate instrument of precision because the work which it does demands the highest accuracy. The copy board, although weighing a ton, can be moved along with the pressure of a finger. Whole structure of the camera is hung from chains so that the mechanism will not be affected by vibrations.

* * *

ASA Membership Reaches New High

Significant is the fact that during 1934 the American Standards association has reached an all-time peak in membership, with forty-seven member-bodies and associate members, representing fifty-two national organizations, and 1244 company members. At intervals through the year twenty-five individual companies have joined the association and ten corporations have voluntary increased their dues.

take advantage of Modern Metals

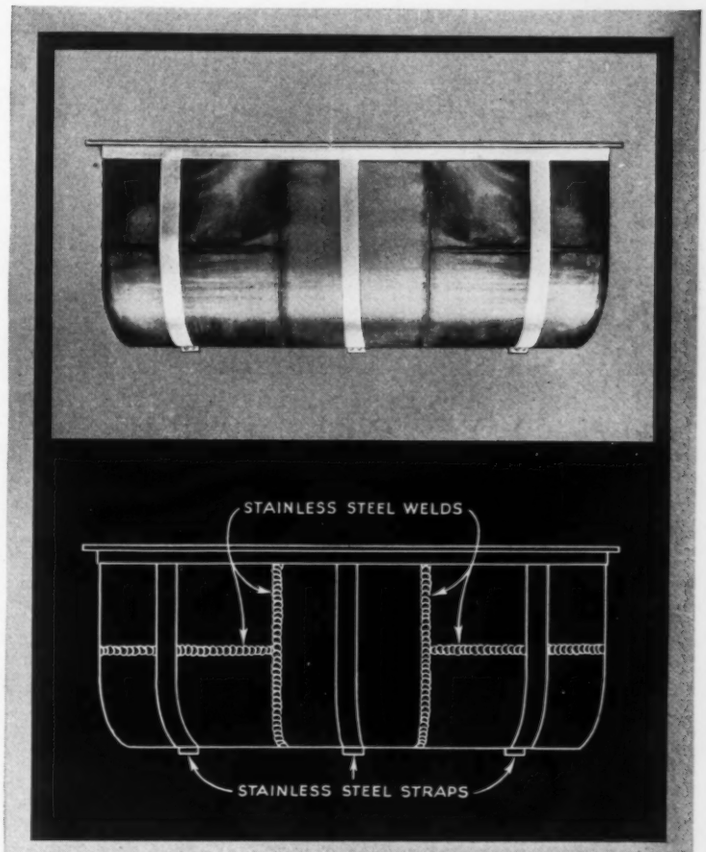
Design for OXWELDING

IN THE fabrication of stainless steel and other corrosion-resistant metals and alloys, oxwelding assures a smooth, corrosion-resistant joint.

The manufacturer of this milk storage tank called on Linde Process Service to help in developing a type of oxwelded joint which would assure a smooth interior wall and avoid warping of the light stainless steel sheet. On Linde's recommendation all seam edges were flanged 3/16 in. Each edge was thus at right angles to the main part of the sheet for the full length of each section. The flanged edges were then placed together and welding started at one end, melting down the flanges to form the weld without the use of welding rod. This procedure completely eliminated any trouble in warping and also gave a joint that was perfectly flush on the inside of the seam. Orders for the construction of additional tanks along identical specifications throughout confirmed the customer's approval of the job.

Perhaps your metal product would be better with oxwelded joints. Linde Process Service can answer this question for you.

A letter or telephone call to the nearest Linde Sales Office will bring you information on this service. There is no obligation—and you will benefit from the many years of experience in the development of the oxy-acetylene process which the Linde organization commands.



In redesigning this 700 gal. tank for milk storage, it was necessary to eliminate an unsanitary and corrosion-ridden condition. With the help of Linde Process Service the tanks were redesigned to be made from stainless steel with oxwelded joints. The inside and outside are permanently free from undesirable laps where germs might lodge or corrosion might start.

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

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Sales Offices: Atlanta Baltimore Birmingham Boston Buffalo Butte Chicago Cleveland Dallas Denver Detroit El Paso Houston Indianapolis Kansas City Los Angeles Memphis Milwaukee Minneapolis New Orleans New York Philadelphia Phoenix Pittsburgh Portland, Ore. St. Louis Salt Lake City San Francisco Seattle Spokane Tulsa

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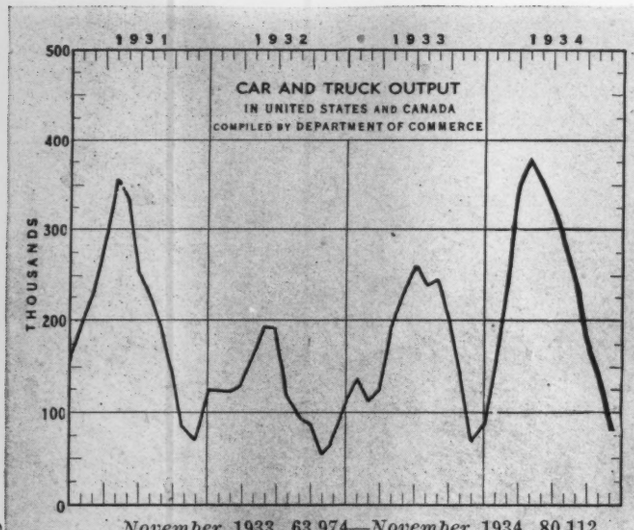
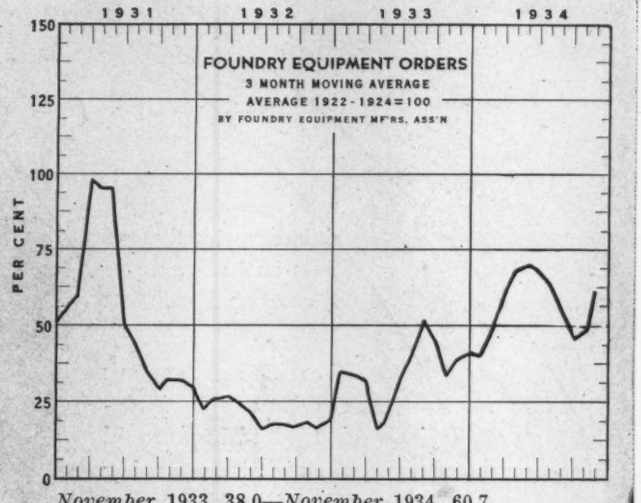
LINDE OXYGEN ▪ PREST-O-LITE ACETYLENE ▪ OXWELD APPARATUS AND SUPPLIES ▪ UNION CARBIDE

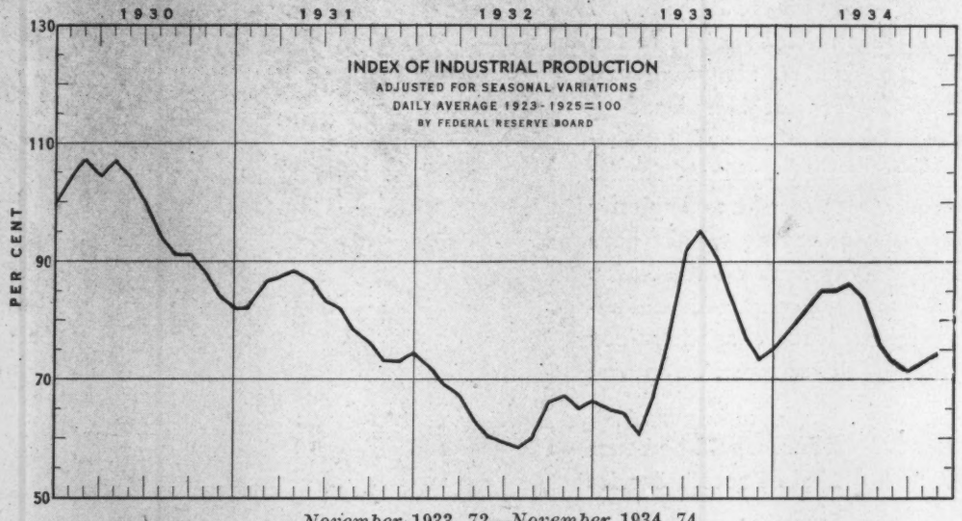
How Is Business?



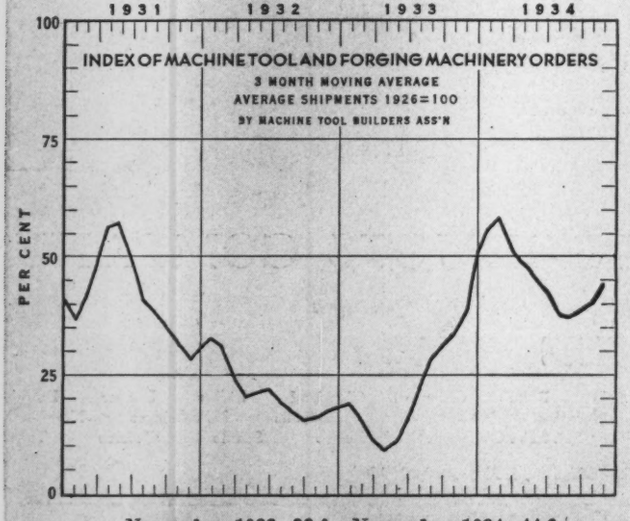
November 1933, 63,974—*November* 1934, 80,112



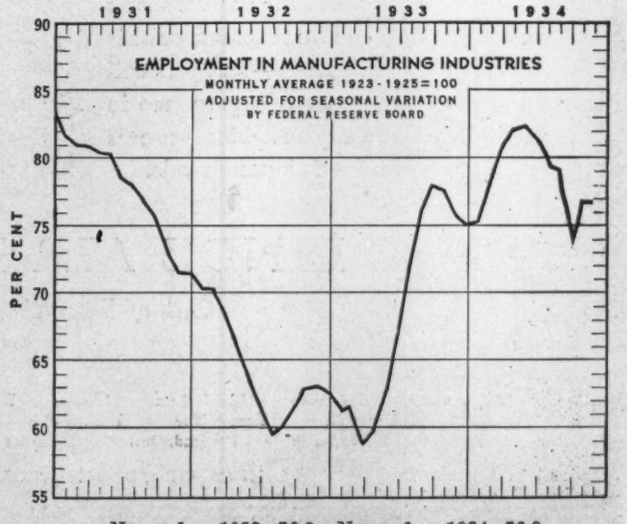
November 1933, 38.0—*November* 1934, 60.7



November 1933, 72—*November* 1934, 74



November 1933, 38.0—*November* 1934, 44.2



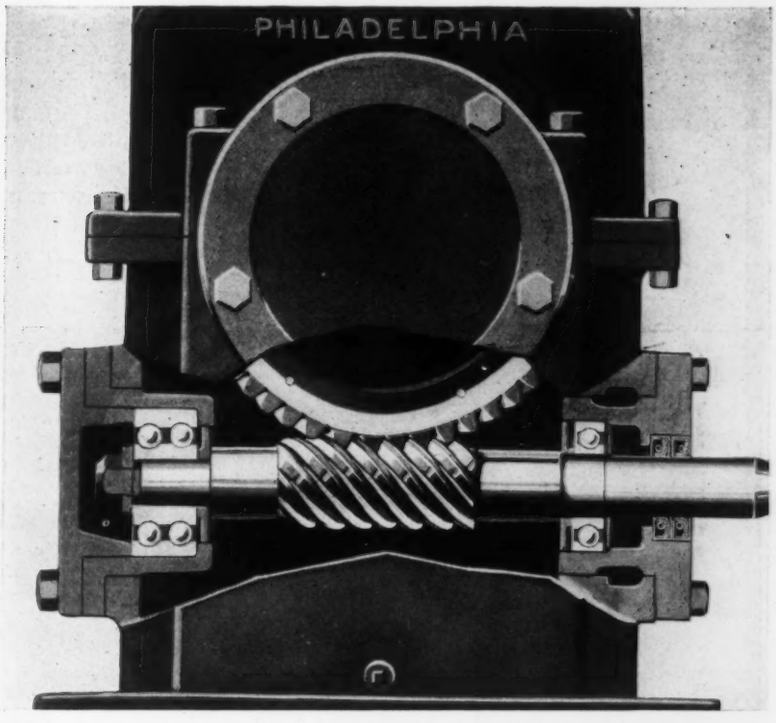
November 1933, 76.2—*November* 1934, 76.8

Bearings that run at

high speed *under* ***heavy load***

insure More Production

● SKF makes practically *all types of anti-friction bearings.* When SKF recommends a particular type of bearing, therefore, you may depend upon it; its recommendations are *unbiased!*



SKF-EQUIPPED – BUILT BY PHILADELPHIA GEAR WORKS, INC.

Take a good look at this Philadelphia Worm Gear Reducer. You'll realize, then, why two SKF Bearings on the worm shaft assembly help this drive to transmit heavy loads at high speeds . . . to promote continuous, smooth, noiseless gear action.

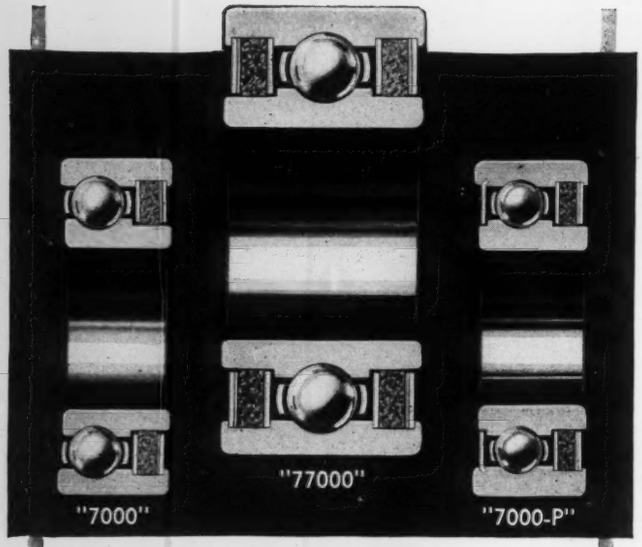
Yet the precision . . . the accuracy . . . the load-carrying ability of SKF are not confined to a single type of bearing, nor to a single type of machine. For there are various kinds of SKF Bearings in drills, grinders, lathes, presses, in nearly every machine that has turning parts . . . and all having these qualities built into them.

SKF lower maintenance costs. They need no adjustment, and they lengthen the life of the machine on which they're installed. They justify the judgment of engineers who depend upon them for unfailing performance. So when you specify machines equipped with SKF, your judgment is backed by the judgment of men who know bearings . . . who know that SKF has a bearing for every need.

SKF

BALL AND ROLLER BEARINGS 3323

SKF INDUSTRIES, INC., Front St. & Erie Ave., Philadelphia, Pa.



SELF-SEALED

The "GREASEAL" Series of Felt-Protected Ball Bearings—in the three types illustrated above—is marked by the following outstanding features which make for better performance and more lasting satisfaction:- thick, closely-fitting felts between removable plates forming an effective labyrinth against the recessed inner ring - - - FELT SEAL REMOVABLE in its entirety for inspection, cleaning or renewal of grease - - - wide, solid inner and outer rings, with maximum contact on shaft and housing, make inserts in housing unnecessary and militate against slippage, looseness, and escape of lubricant past outer ring - - - felt seal within confines of both rings and not exposed to injury - - - constructional characteristics assuring dimensional exactness and quiet running - - - grease capacity ample for long periods of service - - - important features of design covered by basic patents. . . . These three "GREASEAL" types, together with many others in the PRECISION line, constitute THE MOST COMPLETE LINE OF SELF-PROTECTED BEARINGS IN AMERICA. Write for the Catalog. Let our engineers work with yours.

NORMA-HOFFMANN BEARINGS CORPN.
STAMFORD, CONN., U.S.A.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

NOTEWORTHY PATENTS

BECAUSE certain glues have a tendency to alter their characteristics upon standing unused, considerable difficulty has been experienced in obtaining uniform results in the application of this material in the formation of plywood. By eliminating variations in time between mixing and spreading of glue through the use of a newly patented machine the coating of the glue formed is of superior character. This

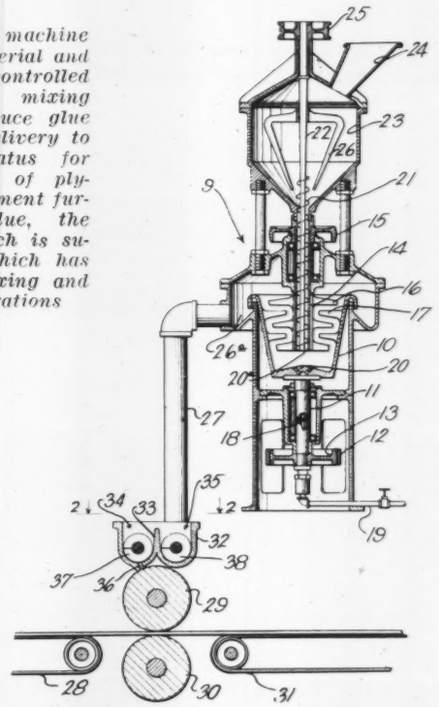
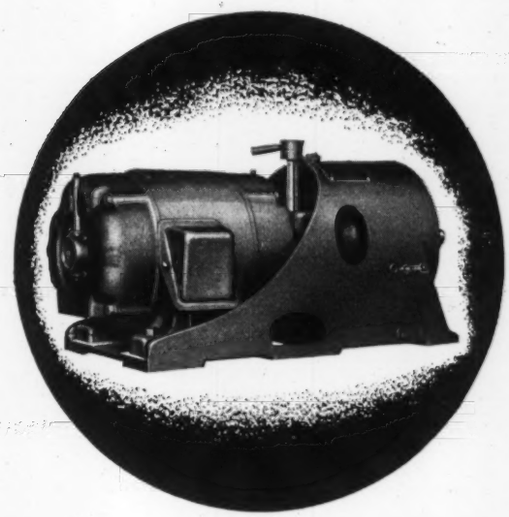


Fig. 1—In this machine dry adhesive material and water are fed in controlled amounts into a mixing chamber to produce glue for continuous delivery to spreading apparatus for the manufacture of plywood. This equipment furnishes fresh glue, the character of which is superior to that which has aged between mixing and spreading operations

mixer, *Fig.* 1, invented by E. H. Merritt for Merritt Engineering & Sales Co., embodies mechanism whereby dry adhesive material and liquid such as water are fed continuously in controlled amounts into a mixing chamber and delivered to a spreading arrangement by which it is applied to the wood plies to be glued together.

Mixing tank 10 is supported on shaft 11 driven by pulley 13. Into this mixing receptacle there extends a tubular shaft 14 rotated by pulley 15 in a direction opposite to that of shaft 11. Shaft 14 and mixing tank 10 are provided with fins 16

New Profits for Motor Users



New Profits result from New Methods, New Applications, New Ideas — PUT TO WORK — to attain greater speed and higher efficiency at lower cost... Here's where Century Motors help! Whether a motor is used in production or as part of a product — whether it's a tough drive, or a job calling for correct speed change adjustment, or protection against water, dust, dirt, explosive vapors — no matter what your condition or problem, Century Engineers can show you the way to profit by correct motor application . . . Single Phase, Polyphase, Direct Current — 1/250th to 600 Horse Power.

CENTURY ELECTRIC COMPANY
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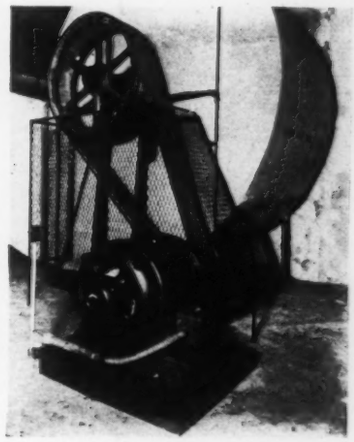
8 Speeds with New Gear Motor

This new gear motor has a wide operating and application range. It is a complete motor type — permitting quick mounting and dismounting of any type multi-speed motor. 2-speed gear and 4-speed motor provides 8 different speeds . . . A very late gear-motor development, already in wide use because it is a dependable and economical drive source where different motor speed requirements must be met... Consult Century Engineers for application and performance data.



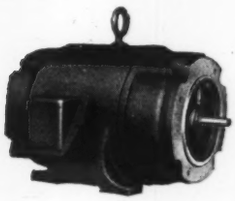
RIGHT — *Century 10/2.5 horse power, 870/440 r. p. m., 3-phase, 440 Volt, Type MS, Multispeed Motor driving Exhaust Fan in Air Conditioning Room of St. Louis Municipal Auditorium.*

Splash Proof Motors

Use them wherever electrically driven machinery comes in contact with splashing water — indoors, outdoors. Protected against water from any angle. Protected against damage from flying or falling chips and heavy particles. Frames and end brackets of refined gray cast iron. Up to 60 Horse Power.

Multi-Speed Squirrel Cage Motors

Especially suitable for Air Conditioning and Refrigerating Equipment — Blowers, Fans, Ventilators, Compressors. Also Agitators, Mixers and similar equipment where correct speed change regulation means economical operation. 2, 3 or 4 speeds — automatic, push button or manual control. 1/8 to 200 Horse Power.



Illustrating Splash Proof Motor for Flange Mounting.

Get This

Just Out—

Bulletin 4-1, page 11 tells all about Century Splash Proof Motors — Shows scientific design of "baffles" that keep out water coming from any angle. Illustrates Slip Ring, Flange Mounting and Two-way Ventilation Splash Proof Motors.

Century

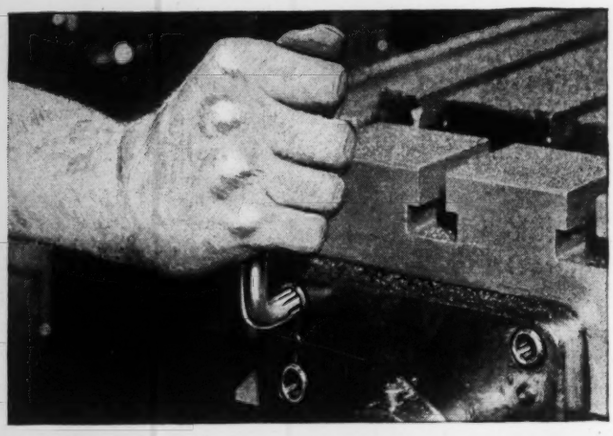
SINGLE PHASE, POLY-PHASE, DIRECT CURRENT
1/250 to 600 H. P.

MOTORS

★

EXTRA FORCE

to make a Tight Set won't round the Sockets in Bristo Screws



STUDY the construction of Bristo Cap and Set Screws and you will see how their unique socket design permits you to use the extra force needed for a tight set without danger of injuring the screw. At the same time, it enables you to effect permanent security with less effort, because of the perfect grip and positive action of the Bristo Wrench in the fluted socket.

These three diagrams explain the Bristo principle and show why it eliminates sidewall pressure—the cause of rounding-out, splitting and jamming.

See how the pressure applied on a Bristo Screw is guided *around*, while in ordinary screws it goes against the socket wall.

Extra holding capacity, longer life, protection against tampering, neater appearance . . . all of these advantages come from the Bristo socket. You may apply them to your work on your product at NO EXTRA COST. Try them for yourself. Write for free samples of Bristo Screws of sizes you use and for complete information.

THE BRISTOL COMPANY, WATERBURY, CONN.
Branch Offices in Principal Cities; Canada: The Bristol Company of Canada, Ltd., Toronto; England: Bristol's Instrument Co., Limited, London, S.E. 14.

TRADE MARK
BRISTO
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Hollow Safety **SET SCREWS**

Socket Head **CAP SCREWS**

and 17, respectively, to agitate the material. Water enters the mixer from pipe 19 through a central channel 18 in shaft 11. In tubular shaft 14 is a conveyor 21 carried on shaft 22 driven by pulley 25. Channel 20[a] in shaft 14 opens into a hopper or supply tank 23 to which an adhesive material in dry form is supplied from time to time through chute 24. Agitator 26 assures continuous feed.

Sides of the mixing tank 10 diverge upwardly so that centrifugal action will assist in the upward movement of the mixture with a consequent regular overflow of uniformly mixed material. This overflow passes into chamber 26[a] and is conducted to trough 35 by pipe 27. Here the mixed glue is applied to a succession of moving wood plies carried by conveyor 28. Spreading roll 29 which contacts the plies is supplied with glue through a long slot 36. Oppositely rotating spiral conveyors 37 and 38 effect a continuous circulation of glue in container 32. The patent is designated No. 1,980,216.

WHILE the audibility of the noise from the ordinary intermittent mechanism of motion picture apparatus sometimes appears low its carrying power is above that of other moving parts of the equipment. With the advent of sound pictures it has become particularly desirable to provide a silent film feeding for record-

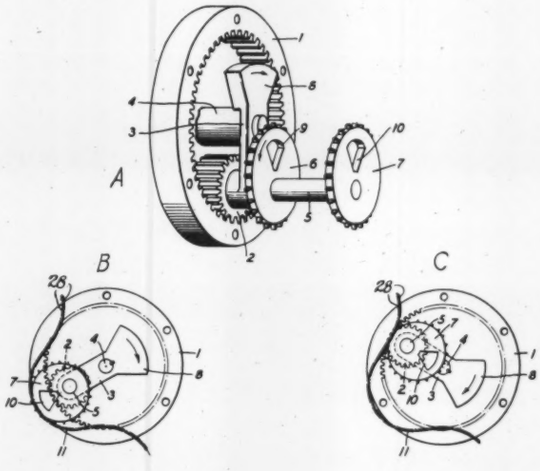


Fig. 2—Intermittent feed device in which the sprocket engages and disengages a film at zero velocity

ing and reproducing machines. To obtain quiet operation Edmund R. Morton has designed and patented an intermittent feed unit, *Fig. 2A*, which engages and intermittently advances a strip of materal such as film. All moving parts of this device have a uniform rotary movement and therefore may be placed in both static and dynamic balance.

The intermittent mechanism covered by the patent consists essentially of a fixed ring gear

IS WEAR ROBBING YOUR PARTS OF THEIR NORMAL LIFE?

Here is a simple method to increase the life of your parts 10 to 25 times

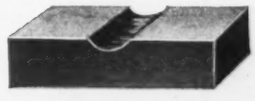
Eliminate rapid abrasive or corrosive wear from the operating equipment you *use in your plant* and *manufacture for sale.* Just a small insert of Carboloy cemented carbide at the point of wear will (1) increase the total productive hours during life of the equipment (2) reduce total part replacement cost (3) reduce the number of "rejects" from your manufacturing equipment due to failure of operating parts and (4) increase the quality of products produced on your equipment.

Carboloy cemented carbide—the hardest metal made—has a high degree of resistance to corrosive and abrasive wear. It is easy to apply, economical to use and—because it can be shaped to your exact requirements—is adaptable to a wide range of applications.

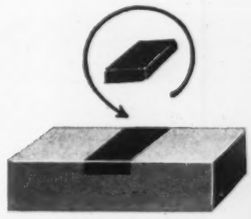
Write for 16-page descriptive booklet WR-35 giving complete information.

CARBOLOY COMPANY, INC.
DETROIT, MICHIGAN
CHICAGO CLEVELAND PHILADELPHIA NEWARK PITTSBURGH

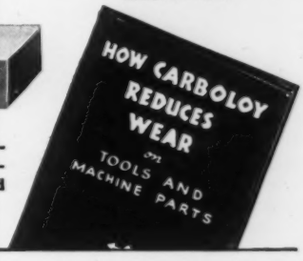
If your tools or machine parts are subject to rapid wear, as for example, on this part



Insert a small piece of Carboloy at the point of wear



The Mark of CARBOLOY
REG. U. S. PAT. OFF.



and you provide trouble-free, efficient service during a greatly increased period of use.

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Bunting Babbitt establishes the minimum coefficient of friction in the industry. Non-adhesive, close grain. Absolute uniformity. Assures practically oil-less operation. The kind of Babbitt you would expect of Bunting. You can get Bunting bearing metals from leading mill supply wholesalers everywhere.

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This plant is in continuous big production of bronze bushings and bearings made to customer's specifications. Free use of patterns and tools for over 30,000 different designs. Engineering and metallurgical counsel without cost or obligation.

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ANTI-FRICTION METAL

1 and a planetary gear 2 mounted on an arm 3 fixed to a constantly rotating shaft 4. As shaft 4 rotates in a clockwise direction the planetary gear 2 meshes with ring gear 1 and thereby is given a retrograde movement in a circular orbit. Shaft 5 carries two eccentrically disposed impellers or sprockets 6 and 7 which, because of their eccentricity, move in a non-circular orbit. By employing a counterweight 8 and designing the impellers with cut out portions 9 and 10 balance can be effected. As the impellers turn they engage film 11 and carry it in a direction opposite to that of shaft 4.

In *Fig.* 2 *B* impeller 7 is shown in engagement with film 11 at the point where it is imparting the greatest movement to the film. In view *C* the impeller is at the point where the sprocket teeth are leaving the film. Through an arrangement of this nature the impeller engages and disengages the film at zero velocity and moves it longitudinally at a constantly changing velocity consisting of a period of acceleration followed by a period of deceleration. A guide 28 maintains the position of the film stationary after it has been released by the impeller. Film perforations thus are in position to be engaged by the impeller sprocket teeth upon the next cycle of rotation in the ring gear.

Number 1,980,220 identifies the patent which has been assigned to Bell Telephone Laboratories Inc.

USE of centrifugal force in much the same manner as employed in some speed governors accomplishes the stripping of a mold in a centrifugal casting machine. The idea recently

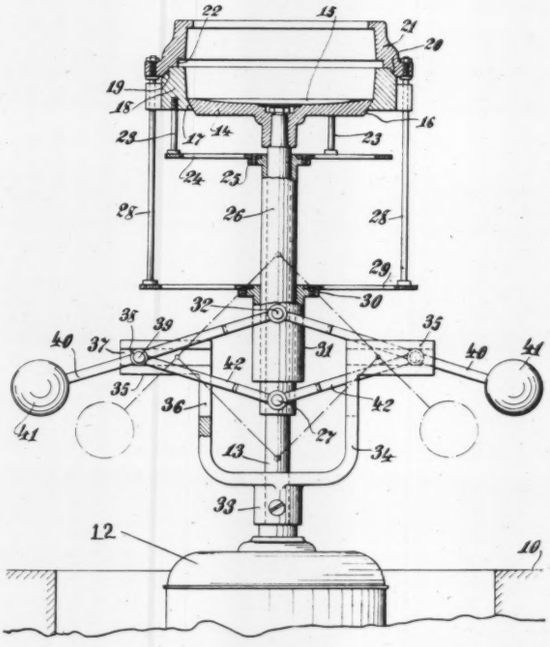
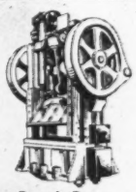
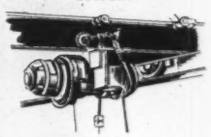


Fig. 3—A centrifugally-operated mechanism is employed to strip a mold from a casting

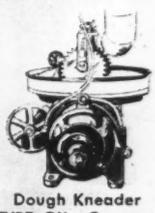
Squirrel-cage Motors
with electrical characteristics and mechanical features
TO MEET EVERY SERVICE



Punch Press
TYPE QF—High Torque—High Slip—Low Starting Current



Hoist
TYPE QL—Line Start—Intermittent Rating—High Torque—Low Starting Current



Dough Kneader
TYPE QX—Constant Torque—Multi-Speed

Bending Roll
TYPE QM—Constant Horsepower—Multi-Speed

No matter what electrical characteristics are required to perfectly adapt a squirrel-cage motor to the circuit limitations or the requirements of the machine it is to drive—you can still have every feature of mechanical superiority for which Fairbanks-Morse motors are known. There need be no compromise with inbuilt sturdiness and stamina—no need to sacrifice ball-bearing efficiency and freedom from trouble—no need to do without the many other mechanical improvements Fairbanks-Morse has made available to motor buyers.

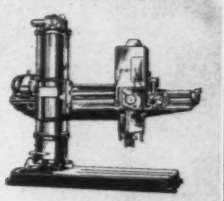
The right motor for the job you want it to perform—that's what the numerous F-M Squirrel-cage Induction Motors offer you. Types designed to fit any conditions that you may require. Each one bearing the same mechanical excellence and trouble-free performance that you and the users of your products naturally expect from Fairbanks-Morse.

For F-M Motors were the *first* to pioneer ball bearings . . . grease tube lubrication . . . one-piece rotor construction . . . and a host of other improvements. Mechanical excellence *plus* electrical performance *plus* sound engineering—that's the Fairbanks-Morse standard to which its motors are built.

We invite you to investigate for yourself the *extra* features built into F-M Motors. Address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 32 branches at your service throughout the United States.

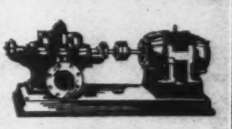
Blower
TYPE QN—Variable Torque—Multi-Speed

Line Shaft
TYPE Q—Normal Torque—Normal Starting Current



Machine Tool
TYPE QS—Normal Torque—Line Start with Low Starting Current

Compressor
TYPE QO—High Torque—Low Starting Current



Pump
TYPE QB—Low Torque—Low Starting Current

Elevator
TYPE QR—High Torque—Intermittent Rating—Low Starting Current

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT *104 Years*

FAIRBANKS-MORSE
MOTORS

6237-EA 40.67

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. . . means positive power transmission, plus-lasting efficiency and economy of operation.

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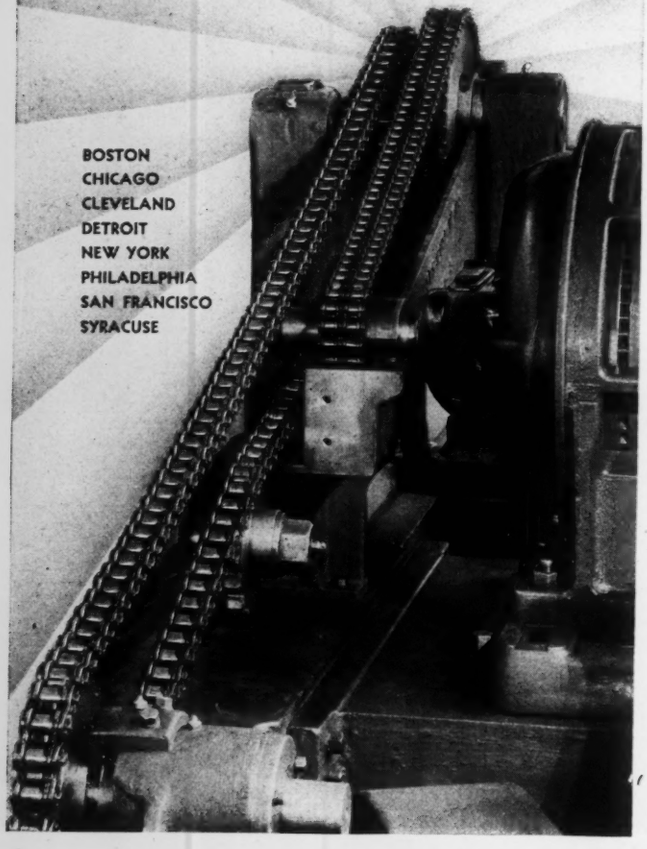

was patented by W. D. Sargent for Durafer Inc. Upon power shaft 13, *Fig.* 3, is fixed sleeve 33 which is formed with extending arms 34 carrying projecting guide arms 35. Outer extremities of arms 40 carry weights 41, while the inner ends are journaled on trunnions 32.

Arms 42 are pivoted at their outer extremities at heads 339 and the inner extremities are bifurcated and journaled on trunnions 27. In this manner heads 39 may move in a plane at right angle to the axis of shaft 13. Weights 41 when moved upwardly due to an increase in the speed of rotation of shaft 13, cause the upper mold section 21 and lower mold section 18 to be closed.

When the speed of rotation of the mold decreases the weights fall back into the position indicated by the broken lines, *Fig.* 3, consequently separating the mold sections. In this fashion the control of the electric motor 12 automatically controls the mold closing and stripping procedure, thereby appreciably facilitating the operation of the centrifugal casting machine.

The patent is designated No. 1,983,146.

Review of Noteworthy Patents

Other patents pertaining to design are described briefly as follows:

MOTOR LUBRICATION—1,982,937—In this design oil is fed to the shaft of a motor by a wick and then is pumped up through the bearing by the groove in the shaft. From the top of the bearing the oil returns to the bottom reservoir. Assigned to Ohio Electric Mfg. Co., Cleveland.

FLUID METER—1,981,797—This invention provides means for adjusting a meter in accordance with variations of temperature and specific gravity of the liquid being measured by the meter. Assigned to S. F. Bowser & Co. Inc., Fort Wayne, Ind.

BALANCING DEVICE—1,980,693—One of the objects of the invention is to produce a pair of adjustable weights for a balancing device that can be adjusted to their proper balancing position in a minimum of time. Assigned to Wagner Electric Corp., St. Louis.

IMPELLER MOUNTING—1,980,337—Provided by this design is pump impeller mounting in which the split ring keeper may be close to the centerline of the impeller, and in which the shaft may be turned down or streamlined so as to provide a greater inlet area of streamline flow to the impeller inlet passage. Assigned to Byron Jackson Co., Los Angeles.

SORTING APPARATUS—1,979,722—One object of this invention is to provide a photo-sensitive sorting apparatus wherein only the illumination immediately affected by a point on the surface of the article under inspection shall impinge on a photo-sensitive device. Assigned to Westinghouse Electric & Mfg. Co.

HIGH PHYSICALS

without elaborate treatment

HERE'S a steel that has been called "fool-proof" from a heat-treating standpoint. It can be brought to the desired tensile strength by a simple quenching and drawing treatment.

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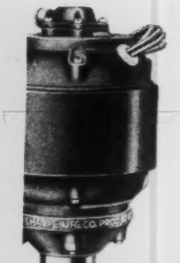
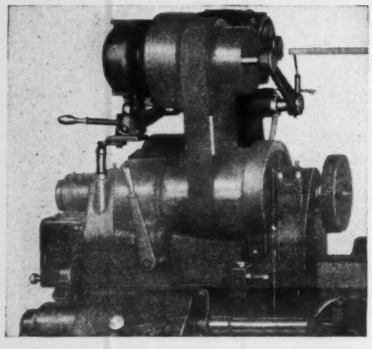


Supplying Coolant
Hydraulic Systems
Forced Feed Lubrication
Maintaining Pressure
General Circulation

May we send specifications?

BROWN & SHARPE MFG. CO.
Providence, R.I.

CULLMAN



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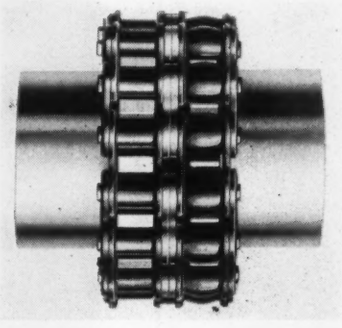
1356 Altgeld St., Chicago, Ill.

New Materials and Parts

Coupling Employs Special Chain

FLEXIBILITY without friction and excessive noise is provided by the flexible chain coupling developed by Baldwin-Duckworth Chain Corp., Springfield, Mass. The results are accomplished by a special double width roller chain, shown herewith. One strand of the chain is equipped with the standard cylindrical rollers



Special double width roller chain is employed in recently introduced flexible coupling

whereas the other strand has convex surface, oversize rollers which provide free operation where shaft deflection and misalignment exist. Permanent shaft deflections up to three degrees can be handled without undue strains. The coupling is self-aligning, and the convex rollers operate on hardened sprocket teeth.

Switch Is Designed for Appearance

MODERN appearance is emphasized in the design of bulletin 4140, a new safety switch introduced by Cutler-Hammer Inc., 328

Front operated, double pole, positive make and break toggle mechanism is used in new switch

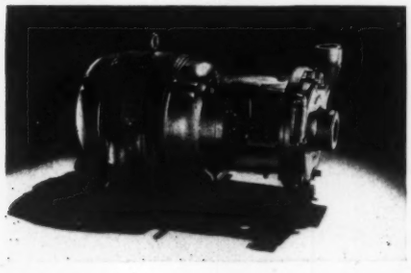
North Twelfth street, Milwaukee, and shown herewith. Fully meeting all requirements for a 30-ampere switch, and listed as standard by

the Underwriters' Laboratories, the new addition to the line of control equipment of the company is particularly adaptable to oil burners, and domestic stokers in basement recreation rooms where appearance is important, to air conditioning equipment, electric unit heaters, as entrance switches and wherever a 30-ampere switch is used.

Although the switch is unusually small, 3½ by 5½ by 3½ inches, ample wiring space has been provided to simplify installation. The toggle mechanism, front operated, is double pole, positive make and break, and the switch is of the fusible type. A special arc resisting laminated horn fiber has been used for the operating lever which has provision for padlocking in either the open or closed position. The switch is finished in black enamel with cadmium trim.

Coupled Pumps Conserve Space

BUILT together to conserve space and to reduce weight, the motor and pump unit recently developed by Fairbanks, Morse & Co., Chicago, forms a compact addition to the company's line of pumps. The unit, shown herewith, consists of a centrifugal side-suction pump with



Any make of standard motor can be used with suction centrifugal pumping units

a closed bronze impeller mounted directly on the shaft of a ball bearing, splash-proof motor. As no alignment problem is encountered with this design, no flexible coupling is necessary.

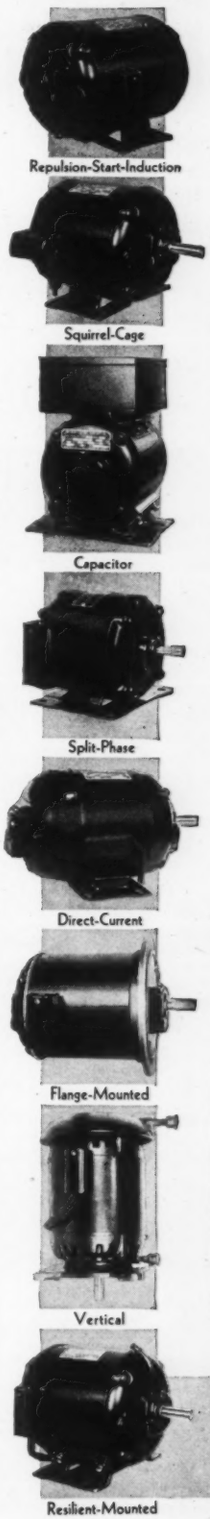
A minimum of space is required for installation and the unit may be placed in any position and at any angle to fit the application. The units are available in capacities from 10 to 250 gallons per minute and for heads up to 190 feet with motors rated from ¾ to 10 horsepower to meet the requirements of a wide range of applications.

Improves Blueprint Papers and Cloths

BLUEPRINT paper and cloth which will not "bleed" is being offered by C. F. Pease Co., 823 North Franklin street, Chicago, as the type "K" speed sensitized papers and cloths. With the new paper or cloth, it is said that prints may

You can

Standardize on Wagner Motors



The Wagner line includes all types of small motors generally applied on motor-driven machinery, making it possible for you to standardize on Wagner motors. Whether alternating or direct current; single or polyphase; open, drip-proof, totally enclosed or explosion-proof; rigid or resilient-mounted, flange-mounted or built-in; sleeve or ball-bearing; horizontal or vertical—there's a Wagner motor now in existence, ready to be applied on the job.

There are 25,000 different type-horsepower-speed combinations of Wagner motors (in ratings up to 400 hp). Certainly, your motor requirements are no greater than that!

For complete details, ask for Bulletin 167 describing Wagner small motors.

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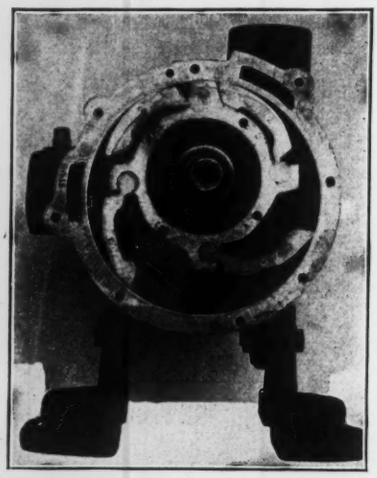
K

REPRESENTATIVE USERS CAN'T ALL BE WRONG



HERE'S WHAT ONE SAYS:

"Your blower has worked continuously (1½ years) and has never given us one minute's trouble or cost us one cent for repairs. We sent you our order for another style H. This blower replaced one of another make and while it does not work in such a hard place as the first one, yet other blowers gave out after rendering approximately nine months' service and during that time were continually in need of repair. The second blower like the first has worked continuously since installing (9 months) and there has been no charge marked up against it for repairs or attention of any kind. The last one (another make) which was new when the first one of your blowers was ordered has been replaced with another style H blower. This blower like the others has been absolutely free from expense."

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ROTARY POSITIVE
AIR PUMPS
VACUUM or PRESSURE

23 Walker St. New York **LEIMAN BROS., INC.** 156 Christie St. Newark, N. J.

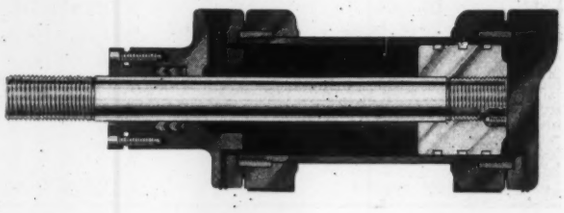
Makers of good machinery for 45 years

always be fully exposed or even over-exposed and yet produce a deep blue and permit the whites to stand out in sharp contrast. It is not necessary to block out behind each blue line print when using the new paper. The papers and cloths are available in all standard lengths, widths, weights and rag stock content, in rolls or standard cut sheets.

Designs Double-Acting Cylinders

DOUBLE-ACTING cylinders for high pressure hydraulic service have been brought out in a new line by Hannifin Mfg. Co., 621 South Kolmar avenue, Chicago. While only one type of mounting is shown in the accompanying illustration, cylinders are available in numerous types and in a wide range of sizes, with practically any length of stroke required. Standard models are designed for working pressures up to 1500 pounds per square inch while special cylinders for higher pressures can be furnished.

Tie rods have been eliminated in the design, thus enhancing the appearance of the part besides improving its ability to function satisfactorily in high pressure service without leakage. Cylinder caps can be removed without disturbing the mounting. End caps can be turned so that the inlet port is located at the top, bottom or either side. Also, each end cap can be positioned independently, making it possible to locate the inlet port at the most convenient point with reference to the machine upon which installation is to be made. Air vent plugs are provided on each side of each cap so that when the cap is mounted with the inlet port at either side or the bottom there is always an air vent plug on the top or upper side.



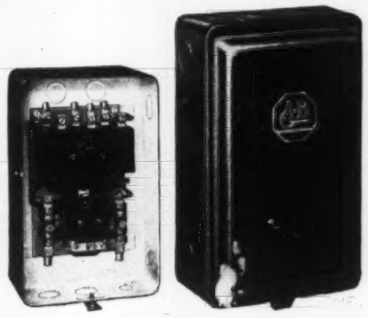
Double-acting cylinders are designed for high pressure hydraulic service applications

Larger Solenoid Switches Developed

THE LINE of solenoid-operated starting switches manufactured by Allen-Bradley Co., 1311 South First street, Milwaukee, has been extended to include 50 and 100-ampere ratings. The two new switches will handle polyphase motors up to 15 horsepower, 110 volts; 30 horsepower, 220 volts; and 50 horse-

power, 440-550 volts. They also can be used for starting single phase motors that may be thrown across the line.

A patented arc hood completely encloses each contactor in an individual compartment from

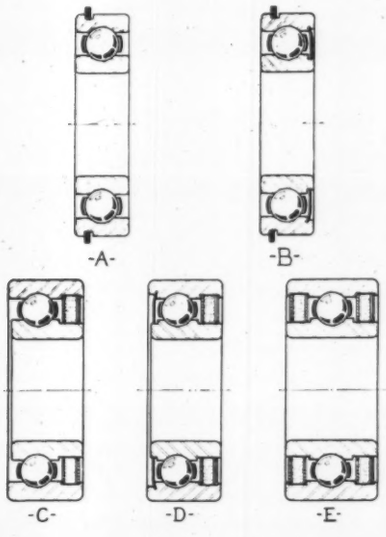


Arcing or heated gases cannot escape to cause flashover in solenoid - operated starting switches

which arcing or heated gases cannot escape to cause flashovers. There is no concealed wiring. Thermal relays give protection against overloads. These relays are of the soldered ratchet type and can be reset without opening the cabinet. The switches, shown herewith, are self-insulated. Each switch unit is mounted upon a metal back plate which can be attached to the machine without further insulation.

Bearings Reduce Assembly Costs

RECENT types of bearings which reduce machining and assembly costs being offered by Norma-Hoffmann Bearings Corp., Stamford, Conn., include the "4000" series of ball bearings, designated A in the accompanying illustration. This series has a snap ring of steel inserted in a groove in the periphery of the outer race, close to one face. This ring, protruding around the outer race, eliminates one

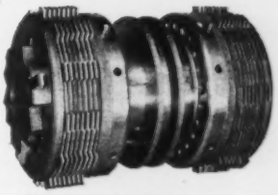


Improved types of ball bearings reduce the machining operations and considerably facilitate assembly

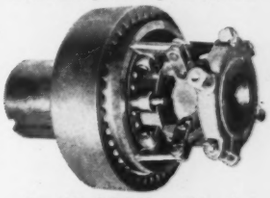
CLUTCH SPECIALISTS SINCE 1917

In 1917 Twin Disc began by being different — building a better clutch for tractors. Twin Disc Clutches have been known for their better design ever since. Today they are famous in every industry for their *unfailing reliability*. The prevailing trend toward product redesign finds the Twin Disc Clutch Company completely organized to meet effectually the greater needs of the designer, manufacturer, and user of industrial machinery. New clutch types of greater adaptability and wider uses have been added to the more than 400 types and sizes of Twin Disc Clutches and Power Take-Off Units already developed by seventeen years of clutch specialization. *Write* for engineering data . . . specific recommendations on request. No obligation.

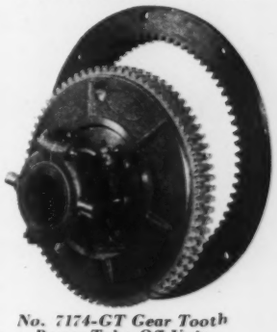
Twin Disc Clutch Company, 1325 Racine St., Racine, Wisconsin.



Close Coupled Duplex Clutch

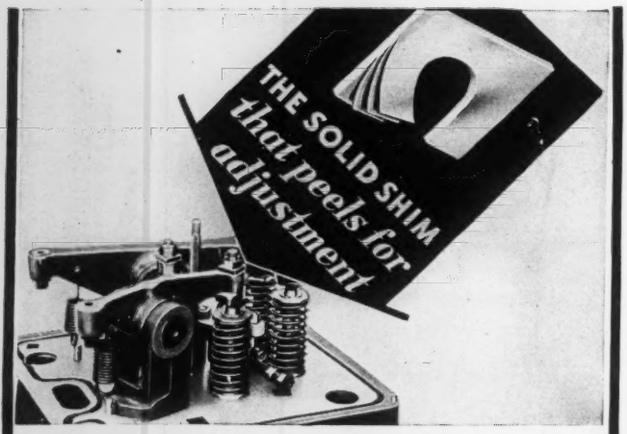


No. 8121 BFT Type Clutch



No. 7174-GT Gear Tooth Power Take-Off Unit

TWIN DISC CLUTCHES



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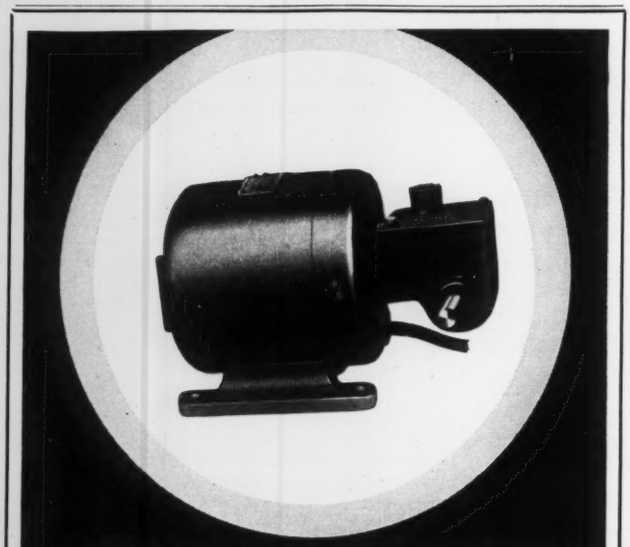

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Signal Universal Motors range in size from 1/500 HP. to 1/10 HP. with and without gear reductions. Induction motors also available from 1/1000 HP. to 1/12 HP. Send us your requirements.

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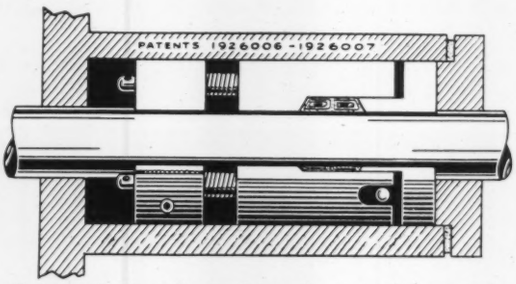
shoulder from the housing. Closely related to this bearing is the "4000-P" series, B, differing only by the addition of one side plate or shield for the retention of grease. Both of these types are available in a range of metric sizes, in both light and medium series.

Three other types of bearings which assist in lowering production costs are: The "7000" series of felt-protected bearings, C, with a removable felt seal between metal plates; the "7000-P" series, D, with single felt seal and one side plate or shield, wholly enclosed for retention of lubricant; and the "77000" series of sealed bearing, E, with two removable felt seals.

Seal Rotates with the Shaft

FOR SEALING centrifugal and rotary pumps working gritty or corrosive fluids, Duralmetallic Corp., 24 Commerce street, Newark, N. J., is offering the Dura Seal, shown herewith, which rotates with the shaft. The seal is unlimited as to the metals and minerals of which it



Rotary shaft seal can be made to resist corrosion by most liquids or gases

may be constructed, therefore it can be made to resist corrosion by practically any liquid or gas used in industry.

The flexible metallic or fibrous packings used are stationary in relation to the shaft or stem, thus reducing the wearing of the shaft and stem. Wear is thrown wholly on the ground joint which offers less than one-sixth the friction surface met with in ordinary packing applications.

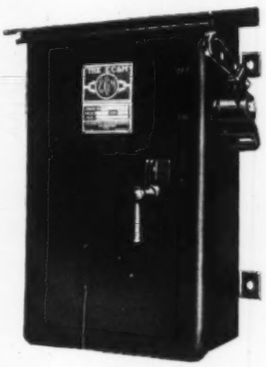
Offers Short-Length Service

SHORT-LENGTH service of semifinished bronze bar stock is being offered by Magnolia Metal Co., Elizabeth, N. J. In addition to standard lengths, 12, 13 and 14 inches, the metal is now available in any assortment of sizes and lengths up to 7 inches outside diameter and from 2 to 14 inches long. Further, the material may be ordered to the exact size required, being semifinished on all surfaces with sufficient extra metal to allow cleaning up to the sizes marked on the bars. This service is of advantage

where single large diameter bearings of a length shorter than the standard bar are needed; where a large assortment of shorter bars is advisable; or where bars large or small already cut to the required length are desired.

Safety Switches Are Weatherproof

WEATHERPROOF, dust-tight type A safety switch in standard sizes from 30 to 600 amperes capacity are being supplied in a new line

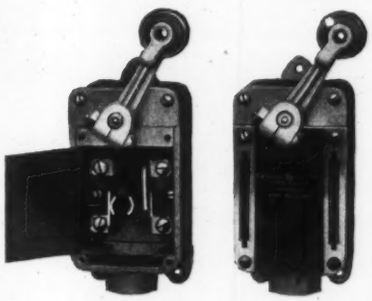


It is impossible to operate improved switch with door open, or to open the door with the switch closed

by Electric Controller & Mfg. Co., 2708 East Seventy-ninth street, Cleveland. These switches, shown herewith, are equipped with fully interlocked door, making it impossible to operate the switch with door open, or to open the door with switch closed. The controls are enclosed in a 10-gage steel cabinet which has been rustproofed before the enamel is applied. A heavy sponge rubber gasket makes a tight seal between the door and cabinet.

Switches Have Spring Return

SMALL, track-type, spring-return limit switches, intended for use in making or breaking control or indicating circuits at a fixed point in the travel of a part of a machine or



An 18-degree movement of the operating arm will operate track-type limit switches

mechanism, have been introduced by General Electric Co., Schenectady, N. Y. The switch, shown herewith, is designated as CR9440-A1A. It has one normally open and one normally

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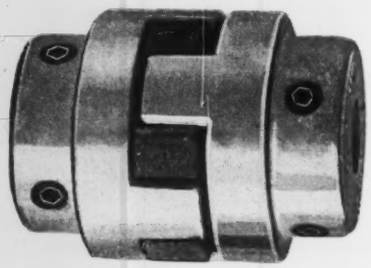

Based on engineering data obtained from special tests and the thousands of L-R EVERLASTING FLEXIBLE COUPLINGS in use, (first introduced in 1928) this excellent unit has been improved in materials and in the design of the resilient spider and load cushion. Flanges are practically indestructible giving the coupling a trouble-free service life from 2 to 5 years before replacement of spider or load cushion is required. Efficient, quiet and so compact as to be practically free from "flywheel action". Because of its inherent tendency to equalize load distribution, specific pressure is kept below maximum permissible. Type A-050-U—3-piece construction with two load cushions is made with shaft diameters up to and including ½" and is especially recommended for small drive and driven equipment. Other types are carried in stock for shafts up to 8", for loads to 350 h.p. at 100 r.p.m. Give us shaft dia., h.p. and r.p.m. and we'll ship a suitable L-R FLEXIBLE COUPLING for testing in your own shop.

Engineering data and full information can be obtained by writing to Lovejoy Tool Works, 5018 West Lake Street, Chicago, Illinois.

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New Year's

RESOLUTION

RESOLVED:

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. . . to continue our policy of honestly advertising and fairly pricing our product . . .

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VIKING PUMP COMPANY
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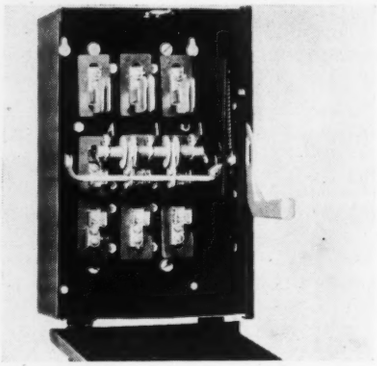
closed circuit. Its maximum carrying and breaking capacity is 5 amperes at 550 volts alternating current and on direct current ranges upward from 0.4 amperes at 550 volts to 2.0 amperes at 115 volts.

The new device is operated by an 18-degree movement of its operating arm from the normal position, an overtravel of 54 degrees being possible without causing damage to the switch. A precision mechanism on the operating arm affords simple, accurate adjustment of the arm to any position around the operating shaft. This mechanism consists of a worm-and-gear arrangement in which the threads on the bolt that clamps the arm to the shaft engage with threads on the shaft. Double-break silver-plated contacts, opening and closing with a sliding connection, assure electrical connections.

Compact Switch Is Introduced

A NEW type of 30-ampere switch which has an elevated removable base for simplified wiring has been developed by Switch & Panel Division of Square D Co., Detroit. The switch, shown herewith, has a front operating handle and the cover opens down instead of at the side. The blades are visible. The unusual construction permits a smaller enclosure than for the conventional type of visible blade switch. Instead of having the usual bulge, the cover design is modernistic with beveled edges. This design is obtainable in 30 ampere 2 and 3-pole fused and unfused and 3 and 4-wire solid neutral.



Unusual construction of new switch permits a smaller enclosure than that used with the conventional type

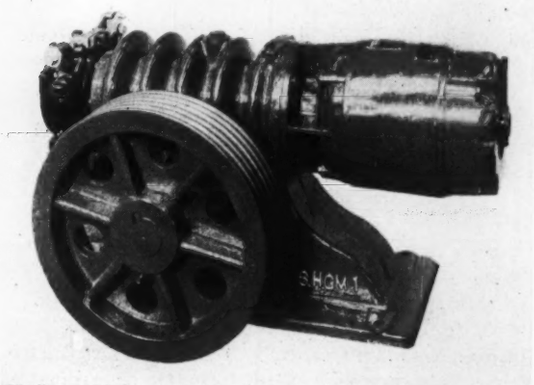
Develops New Spaghetti Tubing

HIGH tension and heat sealing spaghetti tubing, characterized by high dielectric strength, has been developed by George Ulanet Co., 85 Columbia street, Newark, N. J. The tubing, which is extremely tough and which will stand a certain amount of flexing, has a perfectly smooth inside wall. By using a hot pair

of pliers the tubing can be pinched shut and sealed. At present, inside diameters of from 0.025 to 0.250 inch and black, yellow, red and green colors are available. If there is demand for tubing of other colors, the company will produce it.

Introduces Compact Hoist Unit

COMBINING a standard worm type powered gear unit with a solenoid brake mounted on the extended worm shaft and a grooved drum on the slow speed worm shaft Foote Bros. Gear & Machine Co., 5301 South Western boulevard, Chicago, has developed a compact hoist unit adaptable to many applications. The unit,

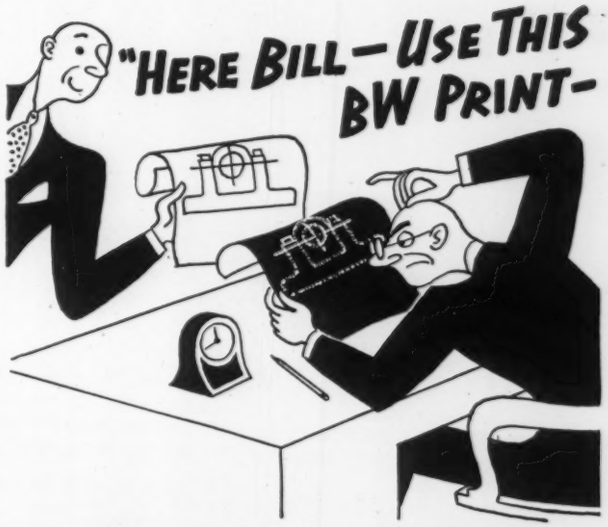


Hoist unit is made up of a gear mechanism combined with solenoid brake, motor and grooved drum

shown herewith, can be furnished in any of the nine standard sizes of worm powered gears available and with any make and type of motor desired. Radiating worm type powered gears can be furnished in the horizontal type as illustrated, in vertical types or in double reduction types with the motor mounted either horizontal or vertical. A complete range of ratios are available, providing slow speed shaft revolutions from 0.55 per minute to 600 per minute. Horsepower capacities range from ¾ to 40.

Bronze Bearing Stock Is Available

PERMITE leaded bronze bearing stock in bar lengths up to 6 feet is now being distributed exclusively by Joseph T. Ryerson & Son Inc., Chicago. The longer lengths make possible the speed production of bearings and bushings on a lathe or screw machine. Permite bars, which have free machinability and an exclusive turned finish, are available in all the standard bronze alloys. Diameters available are ⅝ to 2 inches, by sixteenths, and the stock is turned to an accuracy of plus or minus 0.002 inch.



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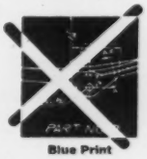
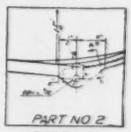


Blue Print



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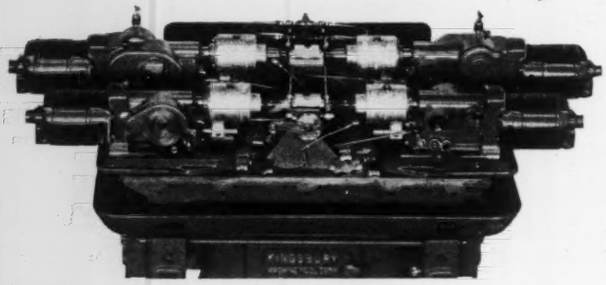

HOLTZER-CABOT will build a motor to fit *your* job.

The trend in modern machine design is to incorporate the motor as an integral part of the driven machine.

By using Holtzer-Cabot flange mounted or built-in motors, your machine will be more compact, better proportioned, and more pleasing in appearance. This reduces cost and increases the efficiency of the machine.

Each of the four heads on this multi-head precision drill shown above is driven by special Holtzer-Cabot flange mounted, ball bearing motors, making the machine more flexible and efficient than a group driven job.

Holtzer-Cabot motors are used by manufacturers of high grade precision machines because experience has proven that these motors give dependable service under gruelling conditions.

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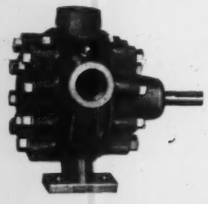

Get the facts on Roper Pumps . . . they deliver real service.

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THE HEART OF POWER **ROPER** PUMPS

—*Cross Sections*—

THOSE designers who put a crimp in the ice delivery business as a future profession now have their guns out for the garbage man. Don't be surprised to see an announcement soon of an electric garbage incinerator which perhaps will dispose of bottles, cans and whatnots in addition to garbage and leave you a small residue that you can spread on the geraniums.

GEORGE WOODLING'S patent articles have become the most widely read of any series published in MACHINE DESIGN, with the possible exception of Wahl's series on springs. Anyone connected with the development of machines and mechanisms should clip these articles for permanent record. Has there been any phase of the patent situation that has not been covered to your complete satisfaction? If there has, tell us and we'll see what we can do about it, or rather, we'll let George do it.

AFTER traveling for a day in the hills of Pennsylvania in a semiliquid snow, your editor can easily see where the inventor of the water-lubricated cutless rubber bearing got his idea.

IF YOU had asked us some time ago who built a machine for wrapping the cotton on those heinous little sticks doctors use for swabs, we would have had to return a stony stare for we never even knew there was such a machine. Some one asked us that question just when we were beginning to believe we had the design field pretty well catalogued. We've found out who makes this type of machine, but don't try to buy one because they aren't for sale. You guessed it, manufacturers of medical equipment design them for their own use.

NOW THAT railroad and street railway equipment builders have snapped out of the doldrums and are utilizing new materials and improved motive power to provide more efficient and better appearing machines, one wonders which branch of the industry will be next to discard archaic design for modern ideas. Road building, farm and even foundry machinery still has a long way to go.

INCIDENTALLY, Christmas toys are close on the heels of the new railroad designs with a miniature Union Pacific streamlined train that is the splitting image of the original. And it runs just as smoothly too. Toy manufacturers really should subsdize designers of larger machines in their rapid advances so that they could bring out new electric toys that would obsolete all those sold previously, thus enabling junior to set up a howl for the latest models!

A DESIGN trend in domestic machines has been to extend the sides entirely to the floor, with the theoretical purpose of eliminating an area that might catch dust and dirt. The labor saving principle is excellent, but even though women's feet closely approach their legendary daintiness, the owner of those feet must have some place to put them. Unless the user of the machine is equipped with gorilla-like arms, it is necessary to bend forward during the entire period worked. We still think it would be a good idea to have every designer work a full day on each new model developed before offering it to the trade.

Coin Unit Protected by Foolproof Devices

(*Concluded from Page* 29)

whereupon it falls onto tray *U* which is in raised position. As the bar *R* moves forward to its original position a spring swings the tray downward and the package slides onto the delivery chute to a position accessible to the operator. When the cigarette delivery plunger is being returned to its "in" position the rack *F*, *Fig.* 2, is lifted to its original position, ready to repeat the cycle, by lever *L*.

Another device to guard against tampering is pawl *W*, *Fig.* 5*b*, which engages the ratchet teeth on the under side of each plunger *L*. This prevents the plunger from being forced backward after it has been pulled out more than ⅜-inch. The stroke must be completed before the plunger can be returned to its initial position.

In localities where it is necessary to make change the designers have developed a penny change device (located in right side of the machine, *Fig.* 4) that embodies a unique idea. The mechanism operates with each complete movement of any one of the six cigarette plungers. Delivery opening of the machine actuates a slide which through a pawl causes the discharge of four pennies into the coin return chute from the brass tube or magazine in which the pennies are tiered. By inserting a plate which is the exact thickness of a penny only three pennies are discharged, inasmuch as the space into which they fall will not accommodate more; likewise the insertion of two plates causes delivery of two pennies, and all three plates allows only one cent to come out.

To accommodate changes or variations in the price of cigarettes the designers have provided a series of five small screw holes *X*, *Fig.* 2, any one of which when fastened with the releasing lever *Y*, determines the price at which cigarettes are to be sold. Beginning with the hole at the bottom of the lever, each succeeding hole represents a change in price of five cents. For example, if the adjustment screw in the releasing lever is attached to the first bottom hole this will bring releasing lever *Y* close enough to rack *F* so that when the rack drops once its weight will rest on the releasing lever and cause the machine to be unlocked for a nickel.

Thus have the designers been able to produce a successful vending machine which embodies ideas that may prove helpful in other fields. Particularly from the standpoint of the use of ingenious mechanisms and die cast parts, this machine is worthy of close observation. Ten patents covering innovations in the unit have been taken out by the Rowe Mfg. Co. Inc., New York.

How the
REEVES VARI-SPEED MOTOR PULLEY
provides infinite speed regulation over a 3:1 range

Applicable directly to the regular shaft of any standard constant speed motor, the REEVES Vari-Speed Motor Pulley forms the actual driving element between motor and machine.

Any speed whatever between minimum and maximum limits is made available to fractions of revolutions, depending on position of motor on its sliding base. By turning a speed control handwheel, the motor is moved forward or backward, as desired.

When motor is *farthest* away from driven shaft, the REEVES V-belt assumes *smallest* arc of contact or diameter formed by the discs, and *minimum* speed is obtained on driven pulley (One disc slides laterally, but is *always* held in *positive* contact with the REEVES V-belt by means of compression spring.)

When motor is *nearest* to driven shaft, the V-belt assumes the *largest* diameter, and *maximum* speed is obtained on the driven pulley.

This simple, compact, efficient, low cost unit, is used as standard equipment on a wide variety of production machines. Furnished in seven sizes for motors from fractional to 7½ H. P.

★

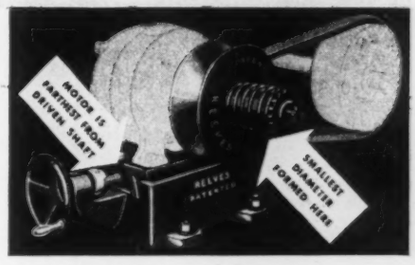
REEVES PULLEY COMPANY, COLUMBUS, INDIANA

Send full description of the REEVES Vari-Speed Motor Pulley and examples as contained in catalog H-300. (1-35)

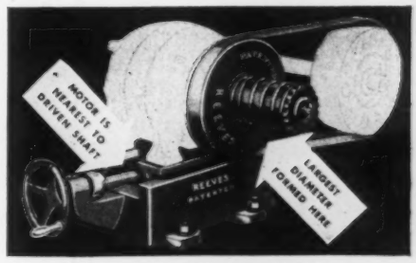
Name.....

Company.....

Address.....

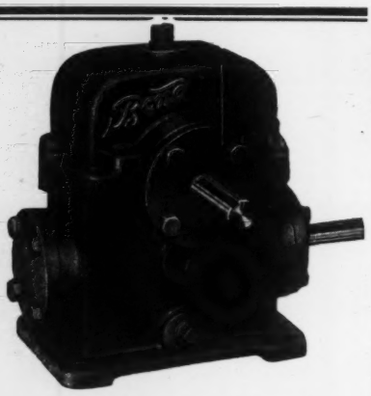


Position at Minimum Speed



Position at Maximum Speed

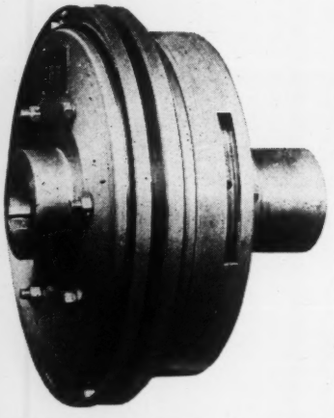
Specify these units on your next installation. . . . . New design features mean *trouble-free* operation!



SEND FOR CIRCULAR MD-33
CHARLES BOND COMPANY
617-23 Arch St., PHILADELPHIA, PA.

Bond
REG. U.S. PAT. OFF.
Stock SPEED REDUCERS

NEW . . . STEARNS Safety Type Magnetic Clutch



This clutch is the first of its type to employ the Magnetic brake principle of operation. It is mechanically closed by powerful springs and opened magnetically in opposition to these springs. Standard Magnetic clutches are closed magnetically and opened mechanically . . the reverse of this safety type clutch.
For continuous clutch engagement and infrequent disengagement, this new Stearns Clutch offers advantages in economy of current consumption, positive clutching action, independent of current, and the usual Magnetic clutch features of smoother acceleration, automatic control, low maintenance cost. Write for complete information.

MAGNETIC MFG. COMPANY
651 TL-S. 28th St. Milwaukee, Wis.

HIGH STEARNS DUTY

ALLOYS (STEEL)—Five advantages available with the use of stainless steels are presented in a recent bulletin of American Rolling Mill Co., Middletown, O. The bulletin includes a presentation of the six finishes available and gives compositions and properties of the stainless steels being offered by the company.

CAST PARTS—The type and quality of castings produced in the malleable foundry of Chain Belt Co., Milwaukee, is presented in a recent bulletin of the company. Illustrations indicate the scope of applications which may be satisfied by the parts.

CLUTCHES—Bulletin No. 200 has just been issued by Magnetic Mfg. Co., Milwaukee, descriptive of a portion of the company's standard line of multiple disk magnetic clutches. Complete specifications have been included on sizes from 6 inches diameter and larger.

CONTROLS (ELECTRICAL)—Cutler-Hammer Inc., Milwaukee, has prepared a bulletin on its new safety switch in the design of which modern appearance is emphasized. The switch is applicable wherever a 30 ampere switch is used.

COUPLINGS—Flexible chain couplings which make use of a special double width roller chain are described and illustrated in bulletin No. 55 of Baldwin-Duckworth Chain Corp., Springfield, Mass. The bulletin also covers the standard semiflexible type couplings manufactured by the company.

DRIVES—American Pulley Co., Philadelphia, has brought out a bulletin which gives a complete description, illustrations and technical data on its tension control motor base which maintains the tension in flat belt drives.

DRIVES—Turbines for mechanical drives are described in three recent bulletins of General Electric Co., Schenectady, N. Y. Type D-58 are single-stage steam turbines, noncondensing, 40 to 400 horsepower. Type D-60 are multistage steam turbines, condensing or noncondensing with oil relay and governor, 100 to 2000 horsepower. Type D5-60 are multistage steam turbines, condensing and noncondensing with steam extraction and multiport valve gear, 100 to 2000 horsepower.

MOTORS—Louis Allis Co., Milwaukee, has prepared an unusual motor price wheel which quickly and accurately tells the frame sizes and list prices of 448 sizes and types of electric motors.

MOTORS—Ohio Electric Mfg. Co., Cleveland, has prepared bulletin No. 214-A, giving complete details of its line of motors for air conditioned heating systems. Standard ratings and dimensions are included.

MOTORS—The new seal-clad induction motors, with protected windings, are described in leaflet 2182 of Allis-Chalmers Mfg. Co., Milwaukee, Wis. The motors are built in ratings up to 25 horsepower, 1800 revolutions per minute, furnished with either ball or sleeve bearings.

PACKING GLANDS AND PACKING—Gits Bros. Mfg. Co., Chicago, has prepared a bulletin on its new line of special metal diaphragm seals for high speed applications. The bulletin gives engineering data, cross sections and complete dimensions.

PACKING GLANDS AND PACKINGS—Rod, plunger, valve stem, piston, sheet packing and gaskets for any service and every requirements are presented in a recent booklet of Johns-Manville Corp., New York. The packings are illustrated and described, and applications are given.

PACKING GLANDS AND PACKING—Durametallic Corp., Kalamazoo, Mich., has prepared a bulletin on its line of packings which include numerous types of flexible and plastic metallic packings, and mechanical seals which rotate with the shaft.

PUMPS—Two-Stage Monobloc centrifugal pumps and single-stage volute centrifugal pumps are presented in two folders of Worthington Pump & Machinery Corp., Harrison, N. J., and engineering data are given.

PUMPS—Compact, close-coupled horizontal centrifugal pumps in a new line are presented in bulletin 108 of Chicago Pump Co., Chicago. The bulletin gives a comprehensive engineering description of the pumps and their characteristics.

REGULATORS—A balanced combustion control system for maintaining fuel-air ratio wherein a master fluid pressure is used responsive to changes in steam pressure is presented in bulletin No. 8 of Brooke Engineering Co. Inc., Philadelphia. The bulletin describes the system and the controls used, and includes typical layouts.

RUBBER—New York Belting and Packing Co., Passaic, N. J., has prepared a new mechanical rubber goods catalog which includes illustrations and complete information on belting, packing, hose and miscellaneous mechanical rubber products. Diagrammatic drawings show various applications. Engineering data are included.

SHAPES—Important features of cold drawn steel are presented in a recent folder of Union Drawn Steel Co., Massillon, O. Strength and other physical properties, machinability, and applications are given.

STEEL PLATES—Sheared plates, pressed shapes and steel blanks made to order are illustrated and described in a bulletin of By-Products Steel Corp., Coatesville, Pa.

TUBING—Summerill Tubing Co., Bridgeport, Pa., is distributing a folder on its line of tubing, the shapes available, and the method of manufacture.

WELDED PARTS AND EQUIPMENT—Lincoln Electric Co., Cleveland, is distributing a well illustrated bulletin descriptive of the use of welding in the fabrication of ships.

WELDED PARTS AND EQUIPMENT—General Electric Co., Schenectady, N. Y., is distributing a bulletin which gives complete information and applications for its line of welding electrodes and accessories. Another bulletin of the company describes recently improved arc welders.

SHAKEPROOF

OUR *New* 1935 CATALOG

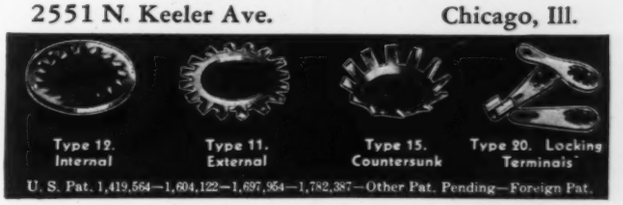
Send for your
FREE COPY TODAY!

HERE it is—a complete presentation of all Shakeproof products, including technical information of great value to every engineer. Describes and illustrates the complete Shakeproof line, including lock washers—both internal and external types—locking terminals, self-locking set screws and the new line of Shakeproof tapping screws. You will find our new 1935 catalog a real help in solving many serious production problems. Be sure to write for your free copy now!

SHAKEPROOF
Lock Washer Company

Distributors of Shakeproof Products
Manufactured by Illinois Tool Works

2551 N. Keeler Ave. Chicago, Ill.

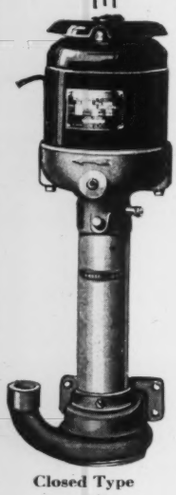


U. S. Pat. 1,419,564—1,604,122—1,697,954—1,782,387—Other Pat. Pending—Foreign Pat.

When You Require Coolant Pumps . . . .

Specify —

"BROWNIE"



Closed Type

A pump which has no packings to leak. No screens to clog. A pump which is entirely self-aligning. "Open" types (for setting on bottom of tank) and "Closed" types (for mounting on outside of tank) 10-100 G.P.M. A pump which handles anything from coolant, impregnated with grit and chips, to oil.

Write for Bulletin No. 10

The TOMKINS-JOHNSON Co.
618 N. MECHANIC ST.
JACKSON, MICHIGAN

1934 INDEX

The index for 1934 issues is ready for distribution. In addition to the usual contents index, a combined itemized index is included.

There is no charge for the index. However, it will be sent only to those readers who previously have requested a copy of each index as published, and to those writing in for this particular copy. MACHINE DESIGN, Penton Building, Cleveland.

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MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

Business Announcements and Sales Briefs

DUMORE CO., Racine, Wis., has moved both its office and factory to a more spacious and modern factory building located at Fourteenth, Racine and Clark streets. In addition to the new building, new equipment is being purchased to aid the efficient production of the motors, grinders and electrical appliances manufactured by the company.

* * *

Revere Copper & Brass Inc. has opened an office at 1511 Telephone building, 1010 Pine street, St. Louis. Edward A. Harbeck is St. Louis district manager.

* * *

Griswold A. Price, since 1931 assistant sales manager at St. Louis for Carnegie Steel Co., Illinois Steel Co. and Tennessee Coal, Iron & Railroad Co., has been made manager succeeding Stillman W. Wheelock who has retired.

* * *

John J. Campbell has been named district sales manager in New York for Eastern Rolling Mill Co., Baltimore. Mr. Campbell will have charge of sales of various grades of sheets made by the company.

* * *

Harry W. Schuetz has been appointed assistant vice president and general manager of sales at the Colona, Pa., division of Pittsburgh Screw & Bolt Co. Richard D. Baker has been named manager of sales in the Pittsburgh district for this company.

* * *

Ernest E. Lee Co., 55 West Jackson boulevard, Chicago, has been appointed by Coppus Engineering Corp., Worcester, Mass., to handle its line of air filters for air compressors, internal combustion engines and ventilating applications.

* * *

Fred S. Winfield, for the last four years associated with automotive and manufacturing companies, has joined the field staff of Aluminum Industries Inc., Cincinnati, manufacturer of Permite products, as sales engineer. Mr. Winfield will have headquarters in Detroit as assistant to B. J. Plumley, district manager.

* * *

Following its consolidation with Minneapolis-Honeywell Regulator Co., Minneapolis, Brown Instrument Co., Philadelphia, will continue as a separate company with its existing organization but as a subsidiary of the Minneapolis organization. Brown Instrument company sales and service facilities will be continued from the present main office and factory and the district offices. Research, development and engineering activities of the two companies will be co-ordinated.

* * *

F. S. Chase, president of Chase Brass & Copper Co., Waterbury, Conn., recently was elected president of Copper and Brass Research association.

* * *

David M. Curry has been appointed to the development and research staff of International Nickel Co. Inc. to carry on work in the nonferrous castings field. Fred J. Walls has become associated with the development and research staff of the company. He will concentrate on development of the use of nickel cast irons in industry.

* * *

Harry M. Green has been appointed manager of mechanical goods sales for the Pacific Coast division of United States Rubber Products Inc. The Pacific Coast division is comprised of the Los Angeles, San Francisco, Portland, Seattle and Salt Lake City branches.

* * *

Steel Products Co., McKees Rocks, Pa., has been named as warehouse distributors for Toncan iron sheets in the Pittsburgh area by Republic Steel Corp., Youngstown, O. Warehouse distributors of Enduro stainless steel recently appointed by the Republic company include: Buhl Sons Co., Detroit; F. W. Heitmann Co., Houston, Texas; and the Woodward Co., Albany, N. Y.

* * *

John R. Gregory has been appointed first assistant general manager of sales for Columbia Steel Co., San Francisco, subsidiary of United States Steel Corp. W. A. Ross is vice president and general manager of sales. Forrest G. Harmon and W. B. Sawyer Jr. have been named assistant managers of sales, J. D. Fenstermacher manager of sales in the San Francisco district, and Harry G. Parcell assistant manager of sales in the San Francisco district.

* * *

New Jersey Zinc Sales Co. has purchased from the estate of Ralph E. Potter the business and good will of David Randall & Co., and will continue this business in the name of the New Jersey Zinc Sales Co. Until further notice the company will operate from the same Boston address, 35 Kilby street, and through the same Boston warehouse, the Albany Terminal Stores. George W. Barragan will continue as New England representative.